

THE PAN-PACIFIC ENTOMOLOGIST



PARSONS—The Lagriidae of California (Coleoptera)	1
TURNER AND CHILLCOTT—Four new species of the <i>Symphoromyia</i> <i>pachyceras</i> complex from California (Diptera: Rhagionidae)	5
GILBERT—Foraging behavior of <i>Trigona fulviventris</i> in Costa Rica (Hymenoptera: Apidae)	21
PAETZEL—Behavior of the male <i>Trypoxylon rubrocinctum</i> (Hymenoptera: Sphecidae)	26
CHANDLER—A revision of the New World genus <i>Formicilla</i> (Coleoptera: Anthicidae)	31
MUCHMORE—A new genus of pseudoscorpions based upon <i>Atemnus hirsutus</i> (Pseudoscorpionida: Chernetidae)	43
EIGHME—A new <i>Pulverro</i> from California (Hymenoptera: Sphecidae)	49
GORDH—Description of a new species of <i>Trjapitzinellus</i> parasitic on Coniopterygidae in California (Hymenoptera: Encyrtidae; Neuroptera)	51
FOSTER AND ANTONELLI—Larval description and notes on the biology of <i>Anthocomus horni</i> (Coleoptera: Melyridae)	56
McCREA—A new species of the flea beetle genus <i>Chaetocnema</i> found on dichondra in California (Coleoptera: Chrysomelidae)	61
PETERMAN—Possible behavioral thermoregulation in <i>Tanarthrus salinus</i> and <i>T. inyo</i> (Coleoptera: Anthicidae)	67
EMMEL, TREW, AND SHIELDS—Chromosomal variability in a Nearctic Lycaenid butterfly, <i>Philotes sonorensis</i> (Lepidoptera: Lycaenidae)	74
CORRECTION	4
EDITORIAL NOTICE	25
SCIENTIFIC NOTES	42, 59, 60, 80
COLLECTION DONATED	48
BOOK REVIEW	55
ZOOLOGICAL NOMENCLATURE	73
PROCEEDINGS	81

SAN FRANCISCO, CALIFORNIA • 1973

Published by the PACIFIC COAST ENTOMOLOGICAL SOCIETY
in cooperation with THE CALIFORNIA ACADEMY OF SCIENCES

THE PAN-PACIFIC ENTOMOLOGIST

EDITORIAL BOARD

R. W. THORP, *Editor*
E. G. LINSLEY R. O. SCHUSTER, *Asst. Editor* E. S. ROSS
P. D. HURD, JR. D. L. BRIGGS, *Editorial Assistant* H. B. LEECH
P. H. ARNAUD, JR. *Treasurer* W. H. LANGE, JR. *Advertising*

Published quarterly in January, April, July, and October with Society Proceedings appearing in the January number. All communications regarding nonreceipt of numbers, requests for sample copies, and financial communications should be addressed to the Treasurer, Dr. Paul H. Arnaud, Jr., California Academy of Sciences, Golden Gate Park, San Francisco, California 94118.

Application for membership in the Society and changes of address should be addressed to the Secretary, Mr. Michael R. Gardner, Laboratory Services, California Department of Agriculture, 1220 N. St., Sacramento, California 95814.

The annual dues, paid in advance, are \$7.50 for regular members of the Society, \$5.00 for student members, or \$10.00 for subscriptions only. Single copies are \$2.50 each or \$10.00 a volume. Make checks payable to *Pan-Pacific Entomologist*.

The Pacific Coast Entomological Society

OFFICERS FOR 1973

J. A. CHEMSAK, *President* PAUL H. ARNAUD, JR., *Treasurer*
C. B. PHILIP, *President-elect* MICHAEL R. GARDNER, *Secretary*

STATEMENT OF OWNERSHIP

Title of Publication: The Pan-Pacific Entomologist.

Frequency of Issue: Quarterly (January, April, July, October).

Location of Office of Publication, Business Office of Publisher, Publisher and Owner: Pacific Coast Entomological Society, California Academy of Sciences, Golden Gate Park, San Francisco, California 94118.

Editor: Dr. Robbin W. Thorp, Department of Entomology, University of California, Davis, California 95616.

Managing Editor and Known Bondholders or other Security Holders: None.

This issue mailed 18 May 1973

Second Class Postage Paid at Lawrence, Kansas, U.S.A. 66044.

ALLEN PRESS, INC.

PRINTED
IN
U.S.A.

LAWRENCE, KANSAS

The Pan-Pacific Entomologist

VOL. 49

JANUARY 1973

No. 1

The Lagriidae of California

(Coleoptera)

CARL T. PARSONS

Manchester Depot, Vermont 05256

In 1965 I published an account of North American *Statira* in which the Lagriidae of California were represented only by an unnamed unique labelled merely "S. Cal." Now there are before me three more species two of which are undescribed. Much more material for study is urgently needed from both California and Baja California, Mexico.

KEY TO CALIFORNIA STATIRA

1. At least middle and posterior tibiae sulcate along nearly entire outer edge. Disc of pronotum irregularly rugulose, not punctate. Third elytral interval with more than eight setigerous punctures 2
Tibiae on outer edge rounded to nearly flattened towards apex. Disc of pronotum obsoletely rugulose or finely granular and sparsely punctate. Third elytral interval with less than eight setigerous punctures 3
2. Elytra and pronotum dark brown to piceous with some specimens having pronota tending to dark rufous. Apical antennal segment of female equal to next 2.5 segments. First elytral interval with 23–33 setigerous punctures, third with 26–39, fifth with 21–28, seventh with 17–26, and ninth with 18–30 setigerous punctures *dumalis* Parsons, n. sp.
Elytra usually dark piceous and feebly shining, pronotum dark rufous and subopaque. Apical antennal segment of female equal to next 2.75 segments. First elytral interval with 11–16 setigerous punctures, third with 14–21, fifth with 12–20, seventh with 10–17, and ninth with 12–20 setigerous punctures *pluripunctata* Horn
3. All femora finely sparsely pubescent. Pronotal lateral margins almost always obliterated anteriorly but becoming distinct posteriorly. Surface of pronotum finely obsoletely rugulose. Female apical antennal segment equal to next 2.25 segments. First elytral interval with 2–3 setigerous punctures, third with 1–3, fifth with 1–3, seventh with 1–2, and ninth with 2–3 setigerous punctures *latitator* Parsons n. sp.
No alternate.

Statira dumalis Parsons, new species

FEMALE.—Uniformly dark brown above with underside and legs slightly paler. Vertex densely finely rugulose, as on disc of pronotum. Apical antennal segment

as long as tenth, ninth, and one-half of eighth segments. Prothorax with width: length as 1:1.05, anterior margin feebly emarginate. Scutellum very finely obsolete punctate and transversely alutaceous. Elytra along inner halves somewhat flattened; striate, with closely placed punctures along striae, intervals finely granular, moderately convex; setigerous punctures about twice as large as strial punctures. First elytral interval with 25 setigerous punctures, second interval with one at base, third interval with 29, fifth interval with 22, seventh interval with 17, and ninth interval with 25 setigerous punctures. All femora finely sparsely pubescent; all tibiae sulcate along outer edge. Length 9.8 mm, width of prothorax 1.7 mm, width of elytra at humeri 2.5 mm.

Paratypes.—Color may be piceous and anterior prothoracic margin truncate in two examples. First elytral interval may have 23–33 setigerous punctures, third interval with 26–39, fifth interval with 21–28, seventh interval with 18–26, and ninth interval with 18–30 setigerous punctures. Length 9.5–11.2 mm, width of prothorax 1.6–2.0 mm, width of elytra at humeri 2.4–3.1 mm.

MALE.—Unknown.

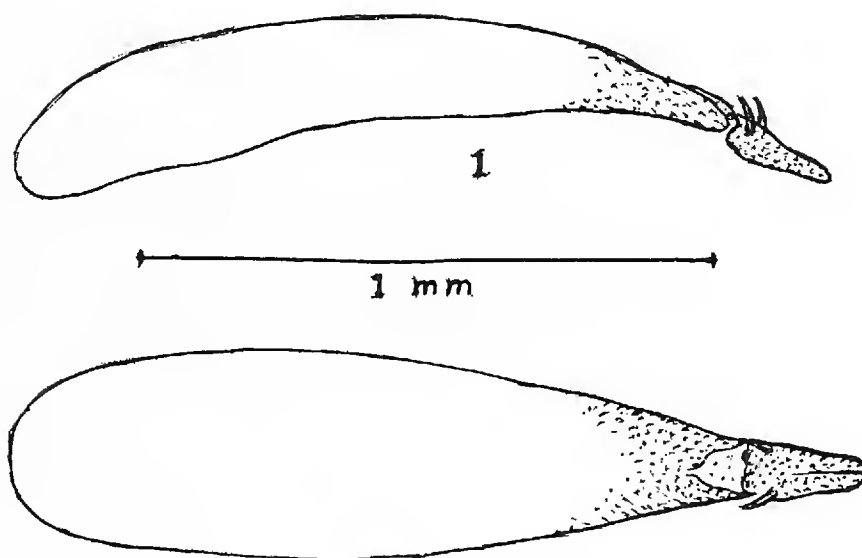
Holotype female, IMPERIAL COUNTY, CALIFORNIA, July 1912, J. C. Bridwell, E. C. Van Dyke. Known only from the type and seven females taken in southeastern California in eastern Riverside County and Imperial County. Paratypes: two same data as holotype; one, Holtville, 23 June 1946; three, Coachella, Riverside Co., 24 May 1928, E. C. Van Dyke; one, Laguna Lake, Imperial Co., 9–11 June 1950. Holotype and five paratypes are in the California Academy of Sciences, one paratype is in the Los Angeles County Museum and one is in the writer's collection.

This species agrees with *S. subnitida* in lateral pronotal line, color, female apical antennal segment, but has many more setigerous punctures and the pronotal surface much more rugulose and not granular. Also *S. dumalis* is related to *S. pluripunctata* differing as follows. Disc of pronotum more flattened than in *S. pluripunctata* or *S. subnitida*, about as convex as in *S. defecta*. Pronotal surface slightly more coarsely rugulose than in *S. pluripunctata* but distinctly more finely rugulose than in *S. hirsuta*. Elytra along inner halves somewhat flattened as in *S. defecta*, less convex than in *S. pluripunctata*, intervals about as convex as in *S. pluripunctata*.

STATIRA PLURIPUNCTATA Horn

Statira pluripunctata Horn, 1888, 15:29.

This species occurs in Utah, Arizona (west to Ajo Mts.), New Mexico, western Texas, and Mexico. Also there is at Ohio State University one typical *S. pluripunctata* collected 1 August 1940 in Yosemite National Park by D. J. and J. N. Knull. Professor Knull (personal communication) states, "We must assume that the locality is correct. We were in



FIGS. 1, 2. Lateral and dorsal views of the aedeagus of *Statira latitator* Parsons n. sp.

a crowded camping area in Yosemite and it is possible that the specimen could have been carried by one of the automobiles." This record needs confirmation.

Statira latitator Parsons, new species

MALE.—Appearing teneral; testaceous, head and antennae fuscous, basal 6–8 antennal segments tending to piceous. Elytra dusky laterally and posteriorly. Vertex very narrow, as wide as width of first antennal segment, surface densely rugulose. Apical antennal segment as long as tenth, ninth, and three-fifths of eighth segments. Prothorax with width:length as 1:1.06; anterior margin truncate. Surface of prothorax very finely obsolete rugulose; prothoracic lateral line obliterated anteriorly becoming distinct posteriorly. Scutellum very finely alutaceous and punctate, laterally and posteriorly with a smoother raised margin. Elytra striate with punctures closely placed along striae; intervals finely granular and moderately convex; setigerous punctures about twice as large as strial punctures. First elytral interval with one setigerous puncture at base and one at apex, third with three at apex, fifth with two at base, seventh with two at base, and ninth with three at apex. All femora very finely and sparsely pubescent; all tibiae rounded on outer edge. Aedeagus with unique pair of recurved dorsal spines (Figs. 1, 2). Length 8.4 mm, width of prothorax 1.4 mm, width of elytra at humeri 2.0 mm.

FEMALE.—As for male except vertex as wide as tenth antennal segment; apical antennal segment as long as tenth, ninth, and one-fourth of eighth segments; prothorax with width:length as 1:0.97; third elytral interval with one setigerous puncture at base and one at apex, fifth with one at base, and ninth with two at apex. Length 9.5 mm, width of prothorax 1.5 mm, width of elytra at humeri 2.3 mm.

Paratypes.—Some specimens darker; occasionally the anterior pronotal margin feebly emarginate; rarely lateral pronotal line extends very finely to anterior angles; first elytral interval with 0–1 setigerous puncture at base and 1–3 at

apex, third with 0-2 at base, 1-3 at apex, fifth with 1-2 at base, 0-1 near apex, seventh with 1-2 at base, and ninth with 2-3 at apex; length 7.5-9.5 mm.

Holotype male and allotype, DEEP CANYON, RIVERSIDE COUNTY, CALIFORNIA collected at light 13 June 1963 E. I. Schlinger. Paratypes: 49 from type locality in 1963, 13 June (36), 16 May (2), 30 May (1), 20 June (1), 22 June (8), and 8 August (1); also 24 May 1964, M. E. Irwin (1); and one 10 April 1961, 1.5 miles north of Puertocito, on the gulf coast of Baja California, Mexico, A. G. Smith. Holotype and allotype in the California Academy of Sciences, paratypes in the Entomological Museum, University of California at Riverside, except for one pair in the writer's collection and a male in the California Academy of Sciences.

This species has the appearance of *S. opacicollis* which differs in having an entire lateral pronotal line, much longer apical antennal segment, more numerous setigerous elytral punctures, and different aedeagus. The prothorax, elytra, and elytral intervals are about as convex as in *S. pluripunctata*.

LITERATURE CITED

- HORN, G. 1888. Miscellaneous Coleopterous Studies. Trans. Amer. Entomol. Soc., 15: 29.
 PARSONS, C. T. 1965. A Key to North American *Statira* (Coleoptera: Lagriidae). Psyche, 72: 241-254.

CORRECTION

EMMEL, T. C. AND J. F. EMMEL. 1971. A new subspecies of *Papilio indra* from central Nevada (Lepidoptera: Papilionidae). Pan-Pac. Entomol., 47: 220-223.

On page 221, lines 3 through 11, the data for the types should read as follows:

Holotype male, JETT CANYON, 6,600 FEET ELEVATION, EAST SIDE OF TOIYABE RANGE, NYE COUNTY, NEVADA, 3 August 1967, John F. Emmel.

PARATYPES.—11 males and 9 females. Data as follows (all localities east side of Toiyabe Range, Nye County, Nevada): 9 males, 5 females, Jett Canyon, 6,500-6,800 feet elevation, 3 August 1967, John F. Emmel, Oakley Shields, and Scott Ellis; 2 males, 2 females, Summit Canyon, 7,000-7,200 feet elevation, 30 June 1968, John F. Emmel and Oakley Shields; 2 females, reared from ova laid by a female collected in Summit Canyon, 7,000 feet elevation, on 30 June 1968, and reared by Chris Henne on *Tauschia parishii* C. and R. at Pearblossom, California, emerged 30 May 1969, and 29 May 1969.—THOMAS C. EMMEL AND JOHN F. EMMEL, *University of Florida, Gainesville 32601*.

Four New Species of the *Symphoromyia pachyceras* Complex from California¹

(Diptera: Rhagionidae)

WILLIAM J. TURNER AND J. G. CHILLCOTT²

Department of Entomology, Washington State University, Pullman

The Nearctic species of biting snipe flies of the genus *Symphoromyia*, last revised by Aldrich (1915), remain poorly known. On morphological bases, including the structure of the male genitalia, the species can be divided into several distinct groups or complexes (Turner, 1971). One group, the *pachyceras* complex, was found to contain several new entities; four of these, all from northern California and closely related to *Symphoromyia pachyceras* Williston, are described herein. Other described species contained within this group include: *S. inquisitor* Aldrich, *S. plumbea* Aldrich and *S. comata* Bigot. Since the original description by Williston (1886), however, the name *Symphoromyia pachyceras* has been incorrectly applied to nearly all the species now included in the complex.

These four new species are being described to make the names available for several biological studies by J. B. Hoy and J. R. Anderson. While the late J. G. Chillcott had begun work on the *pachyceras* complex, his untimely death prevented the results of his initial efforts from reaching publication. His influence on this present work cannot be overemphasized. My appreciation goes to Drs. James B. Hoy and Herbert J. Teskey for making Chillcott's working notes and files available for use during this study.

SYMPHOROMYIA PACHYCERAS COMPLEX DIAGNOSIS

Color essentially black, surface often dusted with gray or brown pollen, third antennal segment convex or straight beneath arista, usually rounded above as much as beneath in lateral view, parafacial area sparsely to densely haired in both sexes, halter dark (yellow only in *S. inquisitor*). Males with eyes narrowly separated forward of ocellar prominence, abdominal segments I-IV often subparallel, segments V and following becoming noticeably constricted, segment IV with short, stiff hairs posterolaterally, abdominal tergite IX with laterally compressed process medially on posterior margin, dististylus elongate, slightly elbowed or curved, often with a ventral lobe. Females dull and densely gray pollinose on head and body with each abdominal tergite bearing dark median spot or, in some species, abdomen

¹ Scientific paper 3810, College of Agriculture, Washington State University. Work was conducted under Project 9043.

² Entomology Research Institute, Canada Department of Agriculture, Ottawa, Ontario, Canada. Deceased, 1967.

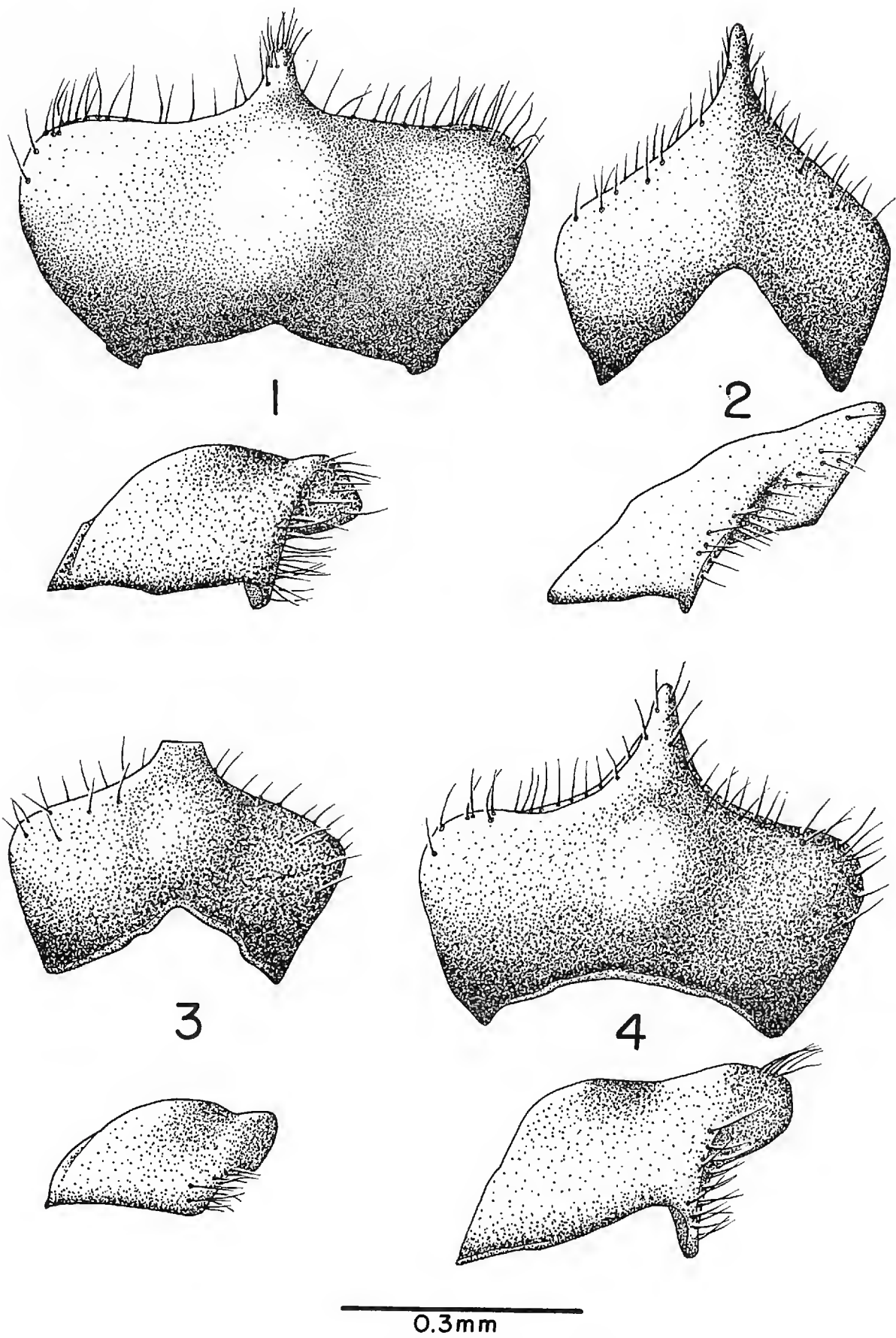
subshiny, only feebly pollinose and without markings, minimum distance between eyes from one-third to two-fifths head width.

Terminology used for morphological structures and surfaces essentially those of Grimshaw (1905), Crampton (1942) and Turner (1971).

Symphoromyia cervivora Turner and Chillcott, new species

Males of this large species are recognized by long postocular hair dorsally which is about one-half length of hair on ocellar prominence; humeral and laterotergal hair mostly black, rarely white; wing membrane nearly clear and hyaline; dististylus with broad, quadrangular basiventral process and short apical arm. Females have black palpi, laterally restricted parafacial hair, abdominal tergites each with a median brown spot surrounded by dark gray or bluish gray pollinosity, mesoscutal vittae brown, faint.

HOLOTYPE MALE.—Length: 7.6 mm. Wing length: 5.9 mm. Head and its appendages, thorax, legs and abdomen black; femur I reddish yellow narrowly at apex, femora II, III similar but less so; halter knob dark brown, stem lighter. Surface subshiny, minutely rugulose at high magnification (45 \times), lightly dusted with gray or bluish gray pollen, most dense on antennal scape, behind eyes, on mesoscutum forward and at sides, on proepimeron, proepisternum, meron, metepisternum, metepimeron, coxae and abdominal sternites, less dense and noticeably more shiny on remainder of head, thoracic pleura, femora and tibiae; abdominal tergites sparsely brown pollinose. Hair mostly black, but golden or white on peristomal sclerites, laterotergite forward, abdominal segments I, II, and on tergite III medially; tergites I, II with black hair along posterior margin; mixed black and white hair present on anterior pronotum and coxa III. *Head*: Eyes separated above by distance slightly less than width of median ocellus; interocellar distance subequal; antennal scape elongate, swollen medially beneath, tapering forward, less so basally, height three-fourths length, greater than height of segment III, hair dense, length beneath subequal to segmental length, longer above; segment III straight beneath arista, forming right angle with dorsal margin about base of arista; palpus elongate, segment III subcylindrical, blunt apically, barely arcuate postmedially, length less than twice length of segment I, bearing dorsal subapical callus, hair dense; labrum shorter than palpus; postocular hair dorsally one-half length of hair on ocellar prominence; parafacial area densely haired, length of hair subequal to that of antennal segment I and to suberect hair of ocellar prominence. *Thorax*: Mesoscutal vittae black, broad, prominently outlined by wide, dense, bluish gray pollinose lines, confluent on postscutum; median vitta bisected by thin, brownish gray pollinose line; lateral vitta complete medially, incomplete forward. Wing membrane nearly clear, gray hyaline, only very faintly infuscated brown about veins apically, stigma dark brown; veins dark brown towards apex, yellow basally; costal vein with row of black, erect hairs basally beneath. Tibia III with long, suberect hair on basal one-half of posteroventral surface, length subequal to tibial thickness, shorter, less erect hairs present on other surfaces. *Abdomen*: From above, segments I-IV subparallel laterally, segments V and following greatly compressed; on sternite IV with broad, rounded posterolateral expansion bearing stiff



FIGS. 1-4. Male IX tergites, dorsal and left side, lateral views: FIG. 1, *Symphoromyia cervivora*; FIG. 2, *S. truncata*; FIG. 3, *S. nana*; FIG. 4, *S. pachyceras* Williston.

hairs; tergite IX apically on posterior margin with laterally compressed process appearing rounded in lateral view (Fig. 1); dististylus bearing quadrangular basiventral lobe and short distal arm (Fig. 6); cercus elongate, narrow and attenuate, apically acute.

FEMALE.—Length: 6.7–9.2 mm. Wing length: 5.9–6.6 mm. Black color obscured by dense pollinosity; femur I narrowly at apex and humerus yellowish red, femur II, III similar but less so; halter knob dark brown to black, stem lighter. Surface typically dull, opaque with almost dense gray or bluish gray pollen overall, becoming less dense on femora and tibiae and often on clypeus, thoracic pleura, and abdominal tergites; upper frons area, head behind and scutellum often lightly tinted with brown pollen, scutal vittae and abdominal terga similar but darker; tergites II and behind each marked with dark brown along front and rear margins and medially by a separate, more or less distinct spot surrounded by dense, pale gray, bluish gray, or dark gray pollen, replaced laterally by dense, gray pollen; surface often subshiny or dull. Hair mostly white but appearing black on antenna, parafacialia, head above and behind, palpus apically, mesoscutum except for humerus and immediately behind, scutellum, femur I, often on mesoanepisternum posterodorsally, abdominal tergites II–IV and sometimes on tergite V medially and along rear margin, completely black on segments VI and following; hair mixed black and white on mesocoxite A. *Head*: Minimum distance between eyes at midfrons about two-fifths head width (MFW/HW ratio: 0.39–0.42); antennal segment I either elongate and swollen medially, tapering at ends or shorter, subtruncate forward, tapering slightly to base, height greatest subapically or medially but varying from nearly three-fourths to almost nine-tenths length, hair sparse, longest ventrally, subequal to segmental height, shorter above; palpal segment II highly convex dorsally, less so beneath, height greatest postmedially, tapering to base, length about twice length of subcylindrical segment I, with short, digitate apical process; parafacial area with hair virtually restricted to lateral portion, bare medially or with only one or two hairs; labrum shorter than clypeal height. *Thorax*: Mesoscutal vittae pale grayish brown, faint, tapering to rear, separated by gray or bluish gray pollinose lines; middle vitta becoming dark gray forward, bisected by narrow, brown pollinose line; lateral vitta incomplete forward, interrupted or not medially, either bifurcate or appearing as elongate stripe and lateral spot on postscutum. Wing membrane nearly clear, gray hyaline, stigma infuscated brown; veins dark brown apically becoming yellow at base; costal vein beneath at base with mixed golden and black hairs or predominantly yellow haired. *Abdomen*: Disticercus elongate, subtruncate or rounded apically, attenuate toward base.

Holotype male, HOPLAND FIELD STATION (4 MI. E. HOPLAND), UNIVERSITY OF CALIFORNIA, MENDOCINO COUNTY, CALIFORNIA, elevation 2,880 feet, 2 May 1969 (W. J. Turner), from male swarm, ca. 1145 P.D.T. CAS type no. 11250. Allotype female, same locality and date as type.

Paratypes, 188 males, 126 females. CALIFORNIA: 43 ♂, 52 ♀, same locality as type (all W. J. Turner collector unless otherwise indicated), "from dry ice Malaise trap," 4 ♀ 14 April 1968, 4 ♂ 20 April 1968, ♂ 4 May 1968, 15 ♂, 2 ♀ 17 May 1968, ♀ 18 May 1968, ♂, 20 ♀ 1 June 1968, 16 ♀ 2 June 1968, ♀ 10

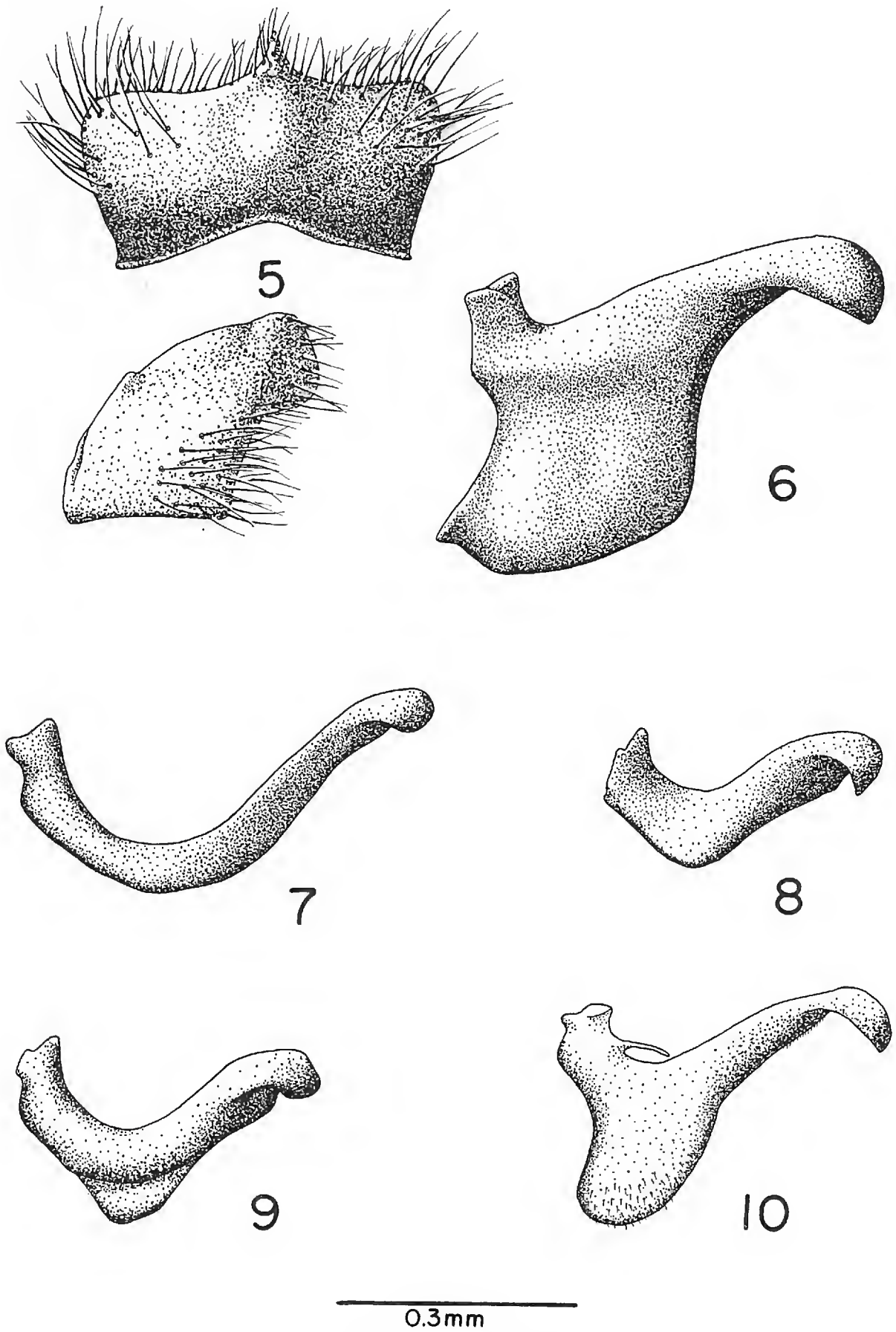


FIG. 5. Male IX tergite, dorsal and left side, lateral view: *Symphoromyia inconspicua*. FIGS. 6-10. Male disticerci: FIG. 6, *S. cervivora*; FIG. 7, *S. truncata*; FIG. 8, *S. inconspicua*; FIG. 9, *S. nana*; FIG. 10, *S. pachyceras* Williston.

June 1968, 4 ♀ 2 May 1969, ♂ 2 May 1969, ♂ 1 June 1969; "from male swarm," ♂ 2 June 1965 (J. R. Anderson), 10 ♂ 2 May 1969, 9 ♂ 28 May 1969; ♀ 14 May 1964 "off ears of deer" (J. R. Anderson); ♀ 8 May 1970 "at light"; 2 ♀ 9 May 1970. ALAMEDA Co.: Berkeley, ♀ 27 April 1954 (W. W. Middlekauff). CONTRA COSTA Co.: Danville, ♀ 9 May 1952 (F. X. Williams); Lafayette, 2 mi. S., 2 ♂ 18 April 1968, "from dry ice Malaise trap," 11 ♂, 2 ♀ 26 April 1968, 2 ♂, 12 ♀ 1 May 1968, 8 ♂, 3 ♀ 9 May 1968, ♂, 2 ♀ 17 May 1968, 7 ♀ 15 May 1969; "from male swarm," 46 ♂ 15 May 1969, Walnut Creek, foot of Shell Rdg., ♂ 15 April 1964 (J. A. Powell); Walnut Creek, 3.5 mi. E., ♂, 2 ♀ 2 May 1969 (M. F. Knudsen). LAKE Co.: Hopland Grade, ♂ 3 May 1961 (S. M. Fidel). MARIN Co.: Alpine Lk., ♂ 8 May 1965 (G. Buckingham), 0.5 mi. N., 3 ♂ 26 April 1961 (R. Garcia); nr. Alpine Lk. (Lily Pond), "from dry ice Malaise trap," 3 ♂ 3 May 1970 (W. J. Turner), 9 ♀ 9 May 1970 (W. J. Turner); "from male swarm," 6 ♂ 3 May 1970 (W. J. Turner), 14 ♂ 9 May 1970 (W. J. Turner); Carson Rdg., ♀ 26 April 1961 (J. A. Powell); Cypress Rdg., ♀ 29 March 1921 (T. Aitkin), ♂ 17 May 1922 (E. P. Van Duzee); Fairfax, ♂ 13 April 1919 (E. P. Van Duzee), 2 mi. W., ♂ 15 April 1966 (J. A. Powell), 2 mi. S.W., nr. Meadow Club, ♂ 7 April 1961 (D. C. Rentz); Inverness, 2 ♂ 14 April 1961 (C. A. Toschi), ♀ 30 May 1964 (C. A. Toschi); Mill Va., 2 ♀ 26 April 1925 (E. P. Van Duzee), ♂ 28 February 1926 (M. C. Van Duzee), ♂ 26 April 1947 (E. L. Kessel), ♂ 28 April 1950 (F. X. Williams); Mt. Tamalpais, ♂ 24 April 1950 (F. X. Williams); Nicasio, 4.4 mi. E., ♂ 13 April 1968 (P. A. Opler); nr. Novato (Umdelelannyoni), 4 ♂ 10 May 1948 (E. L. Kessel), 12 ♂, 2 ♀ 5 May 1951 (E. L. Kessel); Paradise Cove, ♂ 27 April 1947 (E. L. Kessel); San Geronimo, 2 ♀ 23 April 1913 (J. C. Bridwell). NAPA Co.: Lokoya, ♂, 5 ♀ 4 May 1958 (E. G. Linsley, R. F. Smith); Napa, 2 ♂ 7 April 1939 (M. A. Cazier); Samuel Spg., 3 ♂ 29 March 1956 (E. I. Schlinger). SAN FRANCISCO Co.: San Francisco, ♂ (H. Edwards). SAN LUIS OBISPO Co.: Creston, 10 mi. S., ♀ 1 May 1962 (C. A. Toschi); La Panza Cmp., 8 ♀ 25 April 1968 (J. A. Chemsak, J. T. Doyen, D. Veirs). SAN MATEO Co.: Corte de Madera Crk., nr. Portola, ♂ 31 May 1958 (P. H. Arnaud). SANTA CLARA Co.: Herbert Crk., 3 mi. W. New Almaden, "from dry ice Malaise trap," 4 ♀ 28 April 1969 (W. J. Turner); Los Altos, ♂ 17 April 1937 (E. S. Ross); Mt. Hamilton, ♀ 15 April 1947 (G. E. Bohart), 5 mi. E., ♀ 16 April 1955 (D. J. Burdick); San Antonio Va., ♀ 20 April 1948 (R. F. Smith). SOLANO Co.: Mix Cyn., 2 ♂ 14 April 1955 (J. C. Downey), ♀ 13 April 1969 (M. K. Sears); Vacaville, ♀ 6 April 1951 (R. C. Bechtel), ♂ 27 May 1955 (E. Mezger), ♂ 1 April 1963 (P. Richerson), ♂ 4 April 1967 (P. A. Opler). SONOMA Co.: Glen Ellen, ♂ 29 April 1950 (H. B. Leech); Mt. St. Helena, ♀ 30 April 1949 (A. T. McClay). YOLO Co.: Winters, 1 mi. W., ♂ 29 April 1967 (P. B. Schultz), 9 mi. W., ♂ 20 April 1966 (M. R. Gardner). COUNTY UNKNOWN: "California," 2 ♀ (O. T. Baron).

Holotype male, allotype female and thirty-three paratypes, 27 ♂, 6 ♀, will be deposited in the California Academy of Sciences, San Francisco. Additional paratypes have been placed in the collections at the California Department of Public Health, Bureau of Vector Control, Berkeley; Canadian National Collection, Ottawa; Museum of Comparative Zoology, Cambridge; University of California, Berkeley and

Davis; U.S. National Museum, Washington, D.C.; and Washington State University, Pullman.

DISCUSSION.—This species appears quite similar to *S. pachyceras* Williston. Males of both species are large and bear long, dorsal postocular hairs which are one-half the length of hair on the ocellar prominence. Unlike *S. pachyceras*, the wing membrane in *S. cervivora* is essentially hyaline, lacking any infuscation other than the stigma; also the laterotergite is usually black haired. The shape of the dististylus quickly separates males of this species from those of *S. pachyceras* (Fig. 10). Ventrally, the dististylus bears a broad, moderately deep quadrangular-shaped basiventral lobe and short distal arm, appearing somewhat cleaver-shaped in outline (Fig. 6). Females of *S. cervivora* might be confused with *S. pachyceras* as parafacial hair is crowded laterally and the palpus appears black in both. Uniquely, females of this species are bluish gray or a dark gray pollinose on the abdomen above and the surface appears subshiny; dark brown dorsal coloration is limited to a single median spot and narrow, posterior margination. In *S. pachyceras*, for comparison, the surface is primarily dull gray or brownish gray pollinose and often the medial brown area nearly encompasses the entire tergite. In *S. cervivora* the mesoscutal vittae are usually gray but faint, hardly ever as distinct or dark as seen in the other species.

Examination of Williston's *S. pachyceras* type series indicates that the two female cotypes are actually *S. cervivora*. Abdominal pollinosity of both females is dark gray without any tinge of brown; mesoscutal vittae appear dark brown in one female and less distinct, pale gray in the other but definitely conspecific with *S. cervivora*.

The single male cotype specimen is most probably *S. pachyceras*. Positive identification is impossible as the genitalia have been removed and evidently lost at some time in the past. Even without the genitalia, several other morphological features suggest that this specimen is *S. pachyceras* and not *S. cervivora* with which it might be confused. The wing membrane of the type appears almost clear as one would expect of *S. cervivora* and not infuscated which is characteristic of *S. pachyceras*. However, the stigma is now quite pale and suggests that the original duskiess of the wing may have faded somewhat. Williston (1886) noted of his male type that the wings had "a strong brownish yellow tinge" and Aldrich (1915), who later examined this specimen, also indicated the strong wing infuscation. The first antennal segment of *S. cervivora* males is typically swollen beneath medially, its height in lateral view, greater than the height of the third segment. The

pedicle of *S. pachyceras* appears swollen submedially tapering to the apex, its height subequal to or slightly greater than that of the third segment. This type of antennal structure is also seen in the Williston cotype male.

Each Williston specimen bears a label reading "Baron." Essig (1931: p. 552) notes that O. T. Baron, "collected Coleoptera, Lepidoptera and other insects extensively in Mendocino and Fresno counties." Although the precise localities remain unknown, it is quite likely that the *S. pachyceras* type material collected by Baron was taken at least in Mendocino Co., and perhaps even near Hopland, the type locality for *S. cervivora*. It is also not inconceivable that Baron captured a mixed series of individuals representing two closely related species, *S. pachyceras* and *S. cervivora*, as females of several species may be present at any one time in some areas. From the limited Baron material and no further data, Williston associated males of one species with the female pair of the other assuming them to be conspecific.

This species was referred to by Chillcott (*in litt.*) as species "P" for use by Hoy (1966) in his manuscript.

ADULT SEASONAL ACTIVITY.—Collecting dates extend from 28 February until 2 June but this species appears most abundant from late April until mid May.

GEOGRAPHICAL DISTRIBUTION.—Collection records suggest that this species is found primarily at margins of oak woodland areas of the Bay Area and adjacent counties from Mendocino County in the north to Santa Clara County in the south. At several localities, *S. cervivora* is sympatric with most other species of the *pachyceras* group occurring in the northern Coast Range. Several individuals from San Luis Obispo County in the central Coast Ranges appear conspecific with more northern populations and will be treated as such here. These populations may represent the southern most limit of this species.

***Symphoromyia inconspicua* Turner and Chillcott, new species**

Males of *S. inconspicua* are small, faintly dusted with brownish or bluish gray pollen; metatibia bears long suberect hair on both postero- and anteroventral surfaces; humerus black haired; dististylus elongate and slightly elbowed but lacking definite ventral process; ninth tergite broadly rounded in lateral view. Females have yellow palpi and mostly black hair well distributed over parafacial area and beneath first antennal segment.

HOLOTYPE MALE.—Length: 7.0 mm. Wing length: 5.6 mm. Head and its appendages, thorax, legs and abdomen black; femur I narrowly reddish brown

apically, femora II, III similar but less so, halter knob dark brown, stem lighter. Surface gray, bluish and brownish gray pollinose, most dense on clypeus, parafacialia, behind eyes, mesoscutum forward and at sides, on meron, metepisternum, metepimeron, and on coxa III, becoming less pollinose, definitely subshiny on remainder of head, antenna, thoracic pleura except as noted, on coxae II, III, femora, tibiae, and abdominal sternites; scutellum and abdominal tergites lightly dusted with brownish gray pollen, surface subshiny, more dense laterally. Hair essentially black; white hair present on proepimeron, proepisternum, laterotergite forward, abdominal segments I-III, mixed white and black on coxa III and somewhat on segment III behind. *Head*: Features of head and its appendages as described for *S. cervivora* except: antennal segment I elongate, swollen submedially beneath, tapering forward, less so basally, height less than two-thirds length, greater than height of segment III which is roughly kidney-shaped, straight beneath arista, palpal segment II bearing weak anterodorsal callus behind attenuate apex; postocular hair dorsally erect but short, scarcely visible from front. *Thorax*: Mesothoracic vittae broad, faint, almost dull black, nearly confluent on postscutum, separated by narrow, bluish gray pollinose lines; median vitta tapering forward, bisected by thin, brownish gray pollinose line; lateral vitta incomplete forward, uninterrupted medially. Wing membrane definitely infuscated brown, almost concolorous with stigma, darkest near stigma, apically and about veins, nearly hyaline toward base; costal vein beneath base black haired. Tibia III with long, suberect hair on basal one-third to one-half of both postero- and anteroventral surfaces, length greater than tibial thickness. *Abdomen*: Shape as described for *S. cervivora*. Tergite IX apically on posterior margin with laterally compressed process broadly rounded in lateral view (Fig. 5); dististylus elbowed, elongate and narrow, somewhat flattened and polished on posterior surface, smoothly rounded beneath, lacking definite ventral lobe (Fig. 8); cercus elongate, narrow and attenuate, apically blunt. Sternite VIII and hypopygium with hair much longer than height of basistylus.

FEMALE.—Length: 4.7–5.8 mm. Wing length: 4.8–6.7 mm. Black except for femora II, III, and tibiae which are dark brown, nearly black; halter knob similar but becoming yellowish brown on stem; palpus orange yellow; femora I-III yellowed narrowly at apices. Surface dull, rugulose under high magnification (45 \times), nearly opaque with gray pollen, at most feebly shiny over most of head, its appendages and on body except: upper frons area usually brownish gray pollinose, becoming more gray behind head, on scutellum and abdominal sternites; abdominal tergites each marked with indistinct, cupreous-tinged brown pollinose spot on disc and along rear margin, otherwise with subshiny, dark gray or gray pollen becoming brownish gray laterally; mesoscutal vittae dark brown. Hair predominantly white but appearing black on palpus beneath and at apex, head above, mesoscutum except humerus and behind, scutellum, tibiae, femora apically, on abdominal tergites becoming white only laterally on tergites II-IV and on sternites, mostly black or with very few white hairs on parafacial area and antennal segment I beneath. *Head*: Minimum distance between eyes at midfrons more than one-third but less than two-fifths head width; antennal segment I short, height greatest subapically, subequal to length, apex almost truncate, tapering slightly to base, hair sparse, shorter than segmental height, shortest above; segment III convex beneath arista, more rounded ventrally than above when viewed from side, height greater than height of segment I; palpal segment II greatly convex above, hardly

so ventrally, length about twice length of segment I, attenuate or narrowly appended apically, hair sparse, short, absent dorsomedially; parafacialia sparsely but evenly haired; labrum shorter than clypeal height. *Thorax*: Mesoscutal vittae wide, brown, more or less distinct, tapering to rear, separated by wide, bluish gray lines; middle vitta bisected by faint, light brown, pollinose line; lateral vitta incomplete forward, interrupted medially or nearly so. Wing membrane nearly clear, gray hyaline; veins dark brown apically, becoming light brown or yellowish brown at base; costal vein at base yellow haired at most with few black hairs. *Abdomen*: Disticercus elongate, shape subfusiform, rounded or subtruncate at apex, tapering toward base.

Holotype male, HOPLAND FIELD STATION (4 MI. E. HOPLAND), UNIVERSITY OF CALIFORNIA, MENDOCINO COUNTY, CALIFORNIA, elevation 2,350 feet, 21 May 1969 (W. J. Turner), from male swarm, 1055 P.D.T. CAS type no. 11251. Allotype female, same data as type except 28 May 1969, elevation 2,880 feet, and from dry ice Malaise trap.

Paratypes, 77 males, 187 females. CALIFORNIA: 64 ♂, 152 ♀, same locality as type (all W. J. Turner collector unless otherwise indicated), "from dry ice Malaise trap," 2 ♀ 6 May 1964 (J. B. Hoy), 5 ♀ (13-14) May 1964 (J. R. Anderson), 3 ♀ 15 May 1964 (J. R. Anderson), ♀ 19 June 1964 (J. B. Hoy), ♀ 20 April 1966 (J. R. Anderson), ♀ 18 May 1968, 42 ♀ 1 June 1968, 2 ♂, 24 ♀ 2 June 1968, ♂, 14 ♀ 10 June 1968, 3 ♀ 21 June 1968, 2 ♀ 20 April 1969, 2 ♂ 21 May 1969, 4 ♂ 28 May 1969, 3 ♀ 11 June 1969; "from male swarm," 7 ♂ 14 May 1969, 25 ♂ 21 May 1969, 23 ♂, 4 ♀ 28 May 1969; "from deer," 29 ♀ 21 May 1964 (J. B. Hoy), 14 ♀ 28 May 1964 (J. B. Hoy); "off small doe," 2 ♀ 11 June 1964 (J. B. Hoy), ♀ 12 June 1964 (J. B. Hoy). LAKE CO.: No. frk. Cache Crk., Hwy. 20, ♀ 17 May 1961 (D. R. Miller). MARIN CO.: nr. Alpine Lk. (Lily Pond), "from dry ice Malaise trap," ♀ 21 April 1969 (W. J. Turner). MENDOCINO CO.: Booneville, 4 ♂ 1 June 1957 (J. A. Powell). MONTEREY CO.: Arroyo Seco Cmp., ♀ 23 May 1958 (D. D. Linsdale), ♀ 24 May 1958 (D. D. Linsdale), "from dry ice Malaise trap," 4 ♀ 2 June 1970 (W. J. Turner); Bryson, ♀ 20 May 1920 (E. P. Van Duzee). NAPA CO.: Angwin, 1 mi. N., 7 ♂ 9 May 1964 (H. B. Leech); Lokoya, 15 ♀ 4 May 1958 (E. G. Linsley). SONOMA CO.: Armstrong St. Park., ♀ 20 May 1958 (A. C. Smith); Plantation, 4 mi. W., ♂ 8 May 1958 (D. J. Burdick). YOLO CO.: Rumsey, 5 mi. W., 10 ♀ 29 April 1969 (M. F. Knudsen); 9 mi. W., Hwy. 16, ♂ 13 May 1962 (M. E. Irwin).

Holotype male, allotype female and four paratypes, 2 ♂, 2 ♀, will be deposited in the California Academy of Sciences, San Francisco. Additional paratypes have been placed in the collections at the California Department of Public Health, Bureau of Vector Control, Berkeley; Canadian National Collection, Ottawa; Cornell University, Ithaca; University of California, Berkeley and Davis; U.S. National Museum, Washington, D.C.; and Washington State University, Pullman.

DISCUSSION.—Males of *S. inconspicua* are black with lightly dusted brownish or bluish gray pollen, wing membrane is lightly infuscated and hair vestiture is mostly black, especially on the head, palpus, humerus,

thoracic pleura and fourth abdominal tergite. Males may be confused with the smaller, sympatric *S. nana*. This species, however, may be identified by the slightly elbowed dististylus which appears elongate and narrow, but most importantly, flattened and somewhat polished on the posterior surface above an elongate carina; noticeably absent is a definite ventral lobe. The dististylus of *S. nana* appears similar but with a shallow process beneath. Also the metatibia of *S. inconspicua* bears long, suberect hairs on both the postero- and anteroventral surfaces; length of this hair greatly exceeds tibial thickness. In other species, suberect hair is usually present only on a single surface of the tibia. Females typically have orange palpi and black hair present on the basal antennal segment and well distributed over the parafacial area. Color of the parafacial hair should identify this species from similar appearing females having yellowed palpi, particularly *S. nana*. The palpus of some individuals is somewhat grayish along the ventral surface but, in general, the palpus remains wholly orange.

Females of this species were designated species "N" by Chillcott (*in litt.*) for use by Hoy (1966).

ADULT SEASONAL ACTIVITY.—Collection dates range from 20 April to 29 June with most records occurring from mid May until early June.

GEOGRAPHIC DISTRIBUTION.—Known from the type locality and from several other localities in nearby Napa, Lake, Marin, Sonoma and Yolo counties. The range of this species extends south at least into Monterey Co.

***Symphoromyia nana* Turner and Chillcott, new species**

Males of this species are small and sparsely dusted with brownish gray pollen; postocular hair is short and scarcely visible from front; humerus white haired; ninth abdominal tergite small, rounded apically in lateral view; dististylus slightly elbowed with small, shallow medioventral lobe. In females the second palpal segment is orange, palpus and evenly haired parafacial area with mostly white hair.

HOLOTYPE MALE.—Length: 5.2 mm. Wing length: 4.7 mm. Head, antenna, thorax, abdomen and tarsomeres black; humerus, palpal segment II, halter knob, femora, tibiae dark brown, almost black; femora I-III narrowly at apex yellow. Surface dull, almost opaque gray or bluish gray pollinose on parafacialia, clypeus, head behind eyes, antenna, and scutum at sides, becoming less dense and feebly shiny on thoracic pleural area, abdominal sternites, coxae, femora and tibiae; brown or grayish brown, almost dense pollen present on scutum between vittae, less dense on scutellum, abdomen above and mesokatepisternum ventrally, last with cupreous stripe medially. Hair predominantly black, but white on peristomal sclerites, head behind, humerus, on thoracic pleural area except for few black

hairs on mesoanepisternum at rear and on mesokatepisternum below, also white on coxa III, abdominal tergite and on disc of sternites I–IV, mixed white with black on coxa I, femora II, III, abdominal tergites II–IV. *Head*: Eyes separated above by distance subequal to width of median ocellus; interocellar distance subequal; antennal segment I elongate, moderately swollen beneath, tapered slightly towards ends, height three-fifths length, less than height of segment III, hair almost dense, length above subequal to segmental length, shorter beneath; segment III roughly kidney-shaped, straight beneath arista, equally rounded above and below, height nearly three-fifths length of segment I; palpus elongate, narrow, subcylindrical, bearing subapical dorsal callus, segment II slightly incrassate basally, subcylindrical to acute apex, length over twice length of segment I; labrum shorter than palpus; postocular hair dorsally erect but short, scarcely visible from front; hair of ocellar prominence long, curved forward, length subequal to hair of antennal segment I beneath; parafacialia evenly, almost densely haired, length subequal to hair of antennal segment I. *Thorax*: Mesoscutal vittae evident only as wide, black stripes separated by wide, brownish gray pollinose lines; middle vitta bisected by thin brown pollinose line; lateral vitta wider, interrupted medially, delimited laterally and forward by bluish gray pollen. Wing membrane lightly infuscated brown, darkest behind stigma, apically and about veins, stigma barely darker; veins dark brown apically becoming lighter brown toward base; costal vein with black hair beneath. Tibia III with long, suberect hair on basal one-half of posteroventral surface, length greater than tibial thickness. *Abdomen*: Shape as described for *S. cervivora*. Tergite IX with laterally compressed apical process which is small and rounded in lateral view (Fig. 3); dististylus elongate, narrow, curved dorsad, posterior surface flattened, bearing small ventral lobe (Fig. 9); cercus nearly triangular shaped, widest basally, attenuate and blunt apically.

FEMALE.—Length: 4.3–5.3 mm. Wing length: 4.5–4.8 mm. Color and pollinosity as described for *S. inconspicua*. Hair predominantly white as in *S. inconspicua* but appearing black on palpus at apex, antennal segment I above and on femur III; parafacial area and antennal segment I white haired. *Head*: As described for *S. inconspicua* except antennal segment III almost equally rounded above and beneath when viewed laterally. *Thorax*: Mesoscutal vittae, wing membrane and veins as described for *S. inconspicua*; costal vein at base with yellow and black hair. *Abdomen*: As described for *S. inconspicua* female.

Holotype male, HOPLAND FIELD STATION (4 MI. E. HOPLAND) UNIVERSITY OF CALIFORNIA, MENDOCINO COUNTY, CALIFORNIA, elevation 880 feet, 21 June 1968 (W. J. Turner), from dry ice Malaise trap. CAS type no. 11248. Allotype female, same data as type.

Paratypes, 36 males, 165 females. CALIFORNIA: 30 ♂, 159 ♀, same locality as type (all W. J. Turner collector unless otherwise indicated), “from dry ice Malaise trap,” ♂ 26 May 1966 (J. B. Hoy), ♂ 31 May 1966 (J. B. Hoy), 2 ♂ 1 June 1966 (J. B. Hoy), ♂ 2 June 1966 (J. B. Hoy), ♂ 4 June 1966 (J. B. Hoy), 2 ♂ 10 June 1966 (J. B. Hoy), ♂ 12 June 1966 (J. B. Hoy), 5 ♀ 16 May 1968, 3 ♀ 17 May 1968, 11 ♂, 45 ♀ 1 June 1968, ♂, 24 ♀ 2 June 1968, 3 ♂, 32 ♀ 10 June 1968, 4 ♂, 10 ♀ 21 June 1968, ♀ 21 May 1969, 2 ♂ 28 May 1969, ♀ 14 June 1969; “from black tail deer,” 2 ♀ 21 May 1964 (J. B. Hoy), 2 ♀ June 1964 (J. B. Hoy), 3 ♀ 16 May 1965 (J. B. Hoy), ♀ 20 May 1965 (J. B. Hoy), 8 ♀

26 May 1965 (J. B. Hoy), ♀ 27 May 1965 (J. B. Hoy), 2 ♀ 30 May 1965 (J. B. Hoy), ♀ 1 June 1965 (J. B. Hoy), ♀ 2 June 1965 (J. R. Anderson), 5 ♀ 3 June 1965 (J. R. Anderson), 2 ♀ 5 June 1965 (J. R. Anderson), 8 ♀ 23 June 1965 (J. R. Anderson), ♀ 7 July 1965 (J. R. Anderson). MARIN Co.: Alpine Lk., ♂ 19 May 1969 (M. F. Knudsen). MENDOCINO Co.: Booneville, ♂ 1 June 1957 (J. A. Powell). SAN LUIS OBISPO Co.: Pozo, "at light," ♂ 3 May 1962 (J. A. Powell), ♂ 28 April 1962 (C. A. Toschi). SANTA CLARA Co.: Monte Vista, ♀ 15 June 1956; Stevens Crk., nr. San Jose, ♀ 6 July 1954; Wrights, 2 ♀ 12 June 1956. SANTA CRUZ Co.: Aptos Crk., ♀ 13 May 1961 (C. N. Slobodchikoff). TRINITY Co.: Zenia, 2 ♂ 20 June 1935 (M. A. Cazier). YOLO Co.: Winters, 9 mi. W., ♀ 21 April 1962 (H. V. Daly).

Holotype male, allotype female and four paratypes, 2 ♂, 2 ♀, will be deposited in the California Academy of Sciences, San Francisco. Additional paratypes have been placed in the collections at the American Museum of Natural History, New York; California Department of Health, Bureau of Vector Control, Berkeley; Canadian National Collection, Ottawa; University of California, Berkeley and Davis; U.S. National Museum, Washington, D.C.; and Washington State University, Pullman.

TAXONOMIC DISCUSSION.—*Symphoromyia nana* is one of the smallest of *Symphoromyia* species. Males are also unique in that their dististyli are narrow and elbowed with a very shallow medioventral lobe and the ninth tergite is small, rounded apically in lateral view. Females of *S. nana* are quite similar to *S. inconspicua* females. Both species have orange palpi and evenly haired parafacial area but these surfaces appear white haired in *S. nana* and black in *S. inconspicua*. Each abdominal tergite in *S. nana* appears dark brown medially and almost shiny, usually surrounded by gray but often brownish gray pollen. The abdomen of *S. inconspicua* appears more densely gray pollinose and the median spot on each tergite is reduced in size and appears not as dark nor shiny.

Hoy (1966) referred to this species as "O" based on tentative recognition of the species by Chillcott (*in litt.*).

ADULT SEASONAL ACTIVITY.—Collection records extend from 21 April until 7 July. This species is most abundant from mid May to mid June.

GEOGRAPHICAL DISTRIBUTION.—This species is recorded from Trinity County to San Luis Obispo County along the Coast Ranges in association with oak woodland habitats.

***Symphoromyia truncata* Turner and Chillcott, new species**

Males of this species are small; head and thorax somewhat densely dusted with gray to brownish gray pollen; postocular hair short, barely visible from front; ninth abdominal tergite flaring apically, dorsal

angle acute; dististylus elongate, narrow and curved but not elbowed, lacking ventral lobe. Females may be recognized by black palpi; parafacial area sparsely but uniformly black haired; abdomen dark brown, almost shining, only lightly dusted with brownish gray pollen which tends to gray laterally.

HOLOTYPE MALE.—Length: 6.5 mm. Wing length: 5.8 mm. Head and its appendages, thorax, legs and abdomen black; femur I, II narrowly reddish yellow apically, femur III similar but less so; halter knob dark brown, stem lighter. Surface appears minutely rugulose at high power ($45\times$) weakly subshining, gray or brownish gray pollinose on head, antennal segment I, scutum on non-vittate area, thoracic pleura, coxae, abdominal sterna and tergites at sides; frons, ocellar prominence, scutellum and abdominal tergites lightly dusted with brown pollen, becoming quite sparse on tergites. Hair essentially black but noticeably white on humerus and behind, thoracic pleura except rear of mesoanepisternum, on laterotergite at sides, coxa III, and abdominal segments I–III and disc of IV; mixed yellow or white and black hair present on femora II, III, and on abdominal tergites IV posterolaterally, and V; sternite IV with white, stiff hairs on posterolateral lobe. *Head*: Eyes separated above by distance subequal to width of medial ocellus; interocellar distance subequal; antennal segment I swollen medially beneath, tapering forward, less so basally, height three-fourths length, greater than height of segment III, hair dense, length beneath subequal to segmental length, longer above; segment III kidney-shaped, convex beneath arista, more rounded below than dorsally, height one-half length of segment I; palpus elongate, segment II tapered from slightly incrassate base, almost carrot-shaped, scarcely arcuate medially, length just twice length of segment I, bearing small, anterodorsal callus, hair dense; labrum shorter than palpus; postocular hair dorsally erect but short, scarcely visible from front, hair on ocellar prominence long, suberect, subequal to hair of antennal segment I, parafacial area almost densely haired, of similar length. *Thorax*: Mesoscutal vittae present as wide, black median stripe and dark grayish brown, pollinose, lateral stripes separated by medium width gray lines; middle vitta bisected by thin, brownish gray pollinose line; lateral vitta incomplete forward, uninterrupted medially, tapered to rear. Wing membrane lightly infuscated brown, darkest behind stigma and apically, nearly hyaline toward base; costal vein basally beneath with mixed golden and black hair. Tibia III with long, suberect hair on basal one-half of posteroventral surface, length greater than tibial thickness. *Abdomen*: Form as given for *S. cervivora*. Tergite IX with laterally compressed, somewhat flaired apical process, nearly triangular in lateral view (Fig. 2); dististylus elongate, narrow throughout and curved, lacking ventral lobe (Fig. 7); cercus elongate, flat, attenuate from wide base to acute apex.

FEMALE.—Length: 4.9–6.1 mm. Wing length: 4.3–5.3 mm. Color essentially black but obscured by dense or almost dense gray or bluish gray pollen; femur I yellow narrowly at apex, femora II, III similar but less so; halter dark brown, stem brownish yellow. Surface dull, opaque, at most feebly subshiny and gray or bluish gray pollinose on parafacialia, upper frons area, head behind, and on scutellum, becoming less dense, subshiny on clypeus, antennal segment I, non-vittate areas of mesoscutum, thoracic pleural area, head behind and sometimes on mesokatepisternum ventrally; upper frons area often tinged with brown pollinosity,

becoming darker, more dense on mesoscutal vittae; abdominal segments subshining, moderately dusted with gray pollen having cupreous tinge above, more dense and brownish gray laterally, and beneath, tergite I slightly more densely pollinose than following terga. Hair mostly white but usually black on antenna, parafacialia, head above and behind, on mesoscutum, scutellum, mesoanepisternum behind, medially on abdominal tergites II and following, white haired only laterally on tergites II, III and along posterior margin of tergite II; hair mixed black and white on femur I; palpus essentially white haired with black hairs apically. *Head*: Minimum distance between eyes at midfrons between one-third and two-fifths head width, rarely greater (MFW/HW: 0.35–0.42); antennal segment I short, subtruncate forward, tapering slightly to base, height greatest postmedially, ranging from nearly two-thirds of to subequal to length, hair sparse, longest less than segmental height, shortest above; segment III convex beneath arista, subequally rounded above and beneath, height greater than height of segment I; palpal segment II convex above, barely convex or flat beneath, narrowly appended apically, length about twice length of segment I; parafacialia sparsely but evenly haired; labrum just shorter than clypeal height. *Thorax*: Mesoscutal vittae wide, indistinct, dark gray or brown to black, separated by wide, bluish gray pollinose lines; middle vitta widest, indistinct to rear, bisected by faint, narrow, brown pollinose line; lateral vitta interrupted medially or nearly so, often appearing as two elongate spots. Wing membrane clear, gray hyaline, stigma faintly infuscated brown; veins dark brown apically becoming yellow at base; costal vein at base beneath with mixed yellow and black hair. *Abdomen*: Disticercus elongate, rounded apically, tapering toward base.

Holotype male, HOPLAND FIELD STATION (4 MI. E. HOPLAND), UNIVERSITY OF CALIFORNIA, MENDOCINO COUNTY, CALIFORNIA, elevation 1,280 feet, 14 May 1969 (W. J. Turner), from male swarm, 1343 P.D.T. CAS type no. 11249. Allotype female, same data as type except, 17 May 1968, elevation 880 feet, and from dry ice Malaise trap.

Paratypes, 106 males, 162 females. CALIFORNIA: 90 ♂, 150 ♀, same locality as type (all W. J. Turner collector unless otherwise indicated), "from dry ice Malaise trap," ♀ 15 May 1964 (J. R. Anderson), ♂ 30 May 1966 (J. B. Hoy), ♂ 10 June 1966 (J. B. Hoy), 2 ♂ 11 June 1966 (J. R. Anderson), 2 ♀ 20 April 1968, 2 ♀ 4 May 1968, 2 ♂, 7 ♀ 17 May 1968, 2 ♂, 2 ♀ 18 May 1968, 5 ♂, 33 ♀ 1 June 1968, ♂, 10 ♀ 2 June 1968, 10 ♀ 10 June 1968, 2 ♀ 21 June 1968, 4 ♂ 21 May 1969, 3 ♂ 22 May 1969, 4 ♀ 28 May 1969, ♀ 7 June 1969, 9 ♀ 11 June 1969 (J. R. Anderson), 2 ♀ 14 June 1969; "from male swarm," 11 ♂ 12 May 1968, 11 ♂ 21 May 1968, 39 ♂ 14 May 1969, 34 ♂ 21 May 1969, 2 ♂ 28 May 1969; "from black-tail deer," ♀ 29 April 1964 (J. B. Hoy), 7 ♀ 6 May 1964 (J. B. Hoy), 3 ♀ 21 May 1964 (J. B. Hoy), 4 ♀ 9 May 1965 (J. B. Hoy), 2 ♀ 11 May 1965 (J. B. Hoy), 7 ♀ 12 May 1965 (J. B. Hoy), 6 ♀ 16 May 1965 (J. B. Hoy), 3 ♀ 23 May 1965 (J. B. Hoy), 7 ♀ 26 May 1965 (J. B. Hoy), 3 ♀ 27 May 1965 (J. B. Hoy), 3 ♀ 28 May 1965 (J. B. Hoy), 5 ♀ 2 June 1965 (J. B. Hoy), 6 ♀ 23 June 1965 (J. B. Hoy), ♀ 29 June 1965 (J. B. Hoy), ♀ 10 July 1966 (J. B. Hoy); ♀ 15 May 1964 (J. R. Anderson), ♂ 30 May 1966 (J. B. Hoy), 2 ♂ 11 June 1966 (J. R. Anderson). MARIN Co.: Alpine Lk., 3 ♂, 3 ♀ 19 May 1969 (M. F. Knudsen); nr. Alpine Lk. (Lily Pond), "from male swarm," 6 ♂

17 May 1969 (D. D. Munroe); Carson Rdg., 3 ♀ 26 April 1961 (J. A. Powell). NAPA Co.: Middletown, 10 mi. S., ♂ 27 April 1958 (T. R. Haig); Pope Va., ♂ 24 May 1969 (M. K. Sears); Samuel Spr., 2 ♂ 13 May 1956 (C. M. Gardella). SANTA CLARA Co.: Wrights, "collected biting," ♀ 12 June 1956. SANTA CRUZ Co.: Felton, Sta. Cruz Mts., 2 ♀ (15-19) May 1907 (J. C. Bradley). SONOMA Co.: Mt. St. Helena, ♀ 15 May 1951 (E. I. Schlinger); Plantation, ♀ 22 May 1954 (A. Collins). TRINITY Co.: Fawn Ldg., ♀ 28 May 1955 (E. I. Schlinger). YOLO Co.: Rumsey, 5 mi. W., 3 ♂ 29 April 1969 (M. F. Knudsen).

Holotype male, allotype female and four paratypes, 2 ♂, 2 ♀, will be deposited in the California Academy of Sciences, San Francisco. Additional paratypes have been deposited in the collections at the California Department of Public Health, Bureau of Vector Control, Berkeley; California State Department of Agriculture, Sacramento; Cornell University, Ithaca; Canadian National Collection, Ottawa; University of California, Berkeley and Davis; U.S. National Museum, Washington, D.C.; and Washington State University, Pullman.

Chillcott (*in litt.*) and Hoy (1966) recognized *S. truncata* as species "C".

ADULT SEASONAL ACTIVITY.—Collection records range from 20 April until 29 June. This species most common from mid May to mid June.

GEOGRAPHICAL DISTRIBUTION.—This species is found from Trinity County south along the northern Coast Ranges to Santa Cruz County. Throughout its distribution, *S. truncata* seems associated with oak woodland habitats and occurs there sympatrically with several other *pachyceras* group species.

LITERATURE CITED

- ALDRICH, J. M. 1915. The dipterous genus *Symphoromyia* in North America. Proc. U.S. Nat. Mus., 49: 113-142.
- CRAMPTON, G. C. 1942. Guide to the insects of Connecticut. Part VI. The Diptera or true flies of Connecticut. First fascicle. The external morphology of the Diptera. Bull. Conn. Geol. Natur. Hist. Sur., No. 64, pp. 10-175, 17 figs.
- ESSIG, E. O. 1931. A History of Entomology. The Macmillan Co., New York. 1029 pp.
- GRIMSHAW, P. H. 1905. On the terminology of the leg bristles of Diptera. Entomol. Mon. Mag., 16: 173-176.
- HOY, J. B. 1966. The behavior of members of the genus *Symphoromyia* attacking deer in Northern California (Diptera: Rhagionidae). Univ. Kansas, unpublished Ph.D. dissertation. 162 p., 17 tabs., 31 figs.
- TURNER, W. J. 1971. Biosystematics of the California species of *Symphoromyia* (Diptera, Rhagionidae). Univ. California, unpublished Ph.D. dissertation. 412 p., 110 figs.
- WILLISTON, S. W. 1886. Dipterological notes and descriptions. Trans. Amer. Entomol. Soc., 13: 287-307.

Foraging Behavior of *Trigona fulviventris* in Costa Rica

(Hymenoptera: Apidae)

WILLIAM M. GILBERT¹*Department of Zoology, University of California, Davis 95616*

A colony of the stingless bee *Trigona fulviventris fulviventris* Guérin was observed during the dry season between 8 and 12 March 1969, at The Tropical Science Center field station, about four km southwest of Rincon de Osa, Puntarenas Province, Costa Rica. Observations centered around a nest of *T. fulviventris* at the hollow base of a large, buttressed tree one m from the bank of the Rio Agua Buena. The entrance tube projected between two buttresses, about 20 cm above the ground surface.

The diurnal activity cycle of *T. fulviventris* was determined by sampling the numbers of bees leaving and entering the nest on 10 March. Six one minute counts, three of bees leaving and three of bees entering the nest entrance tube, were made at hourly intervals from 0552 until 1750 (sunrise, 0540, sunset, 1741), with one series of counts being made on the half hour around 1730. The bees were also observed at the hive before sunrise on 11 March. Other aspects of *T. fulviventris* behavior, as well as the behavior of other stingless bees, were observed and recorded at the nest site and elsewhere in the study area. Additionally, eight cardboard feeding stations were placed on trees at varying distances from 5 to 100 m and in various directions from the study nest. These stations were baited with 50% honey solution and checked for bees at regular intervals.

RESULTS.—The diurnal activity cycle of *T. fulviventris* was recorded as departure and return rates per minute from the study nest (Fig. 1). The first observed activity was at 0523 on 11 March (sunrise 0540) when bees, observed by flashlight, were clustered at the lip of the mud nest entrance. Individual bees would leave the cluster and fly toward the flashlight beam at that time, but natural departure from the nest did not appear to have begun. Bees could be seen in the dim light at 0535 to be leaving the nest in great numbers. A few were returning. By 0550 large numbers of bees were both leaving and returning to the nest.

The greatest activity period of *T. fulviventris* was in the morning hours from the onset of activity at about 0530 until about 1000, during

¹ Present address—1996 Catalpa Way, Hayward, California 94545.

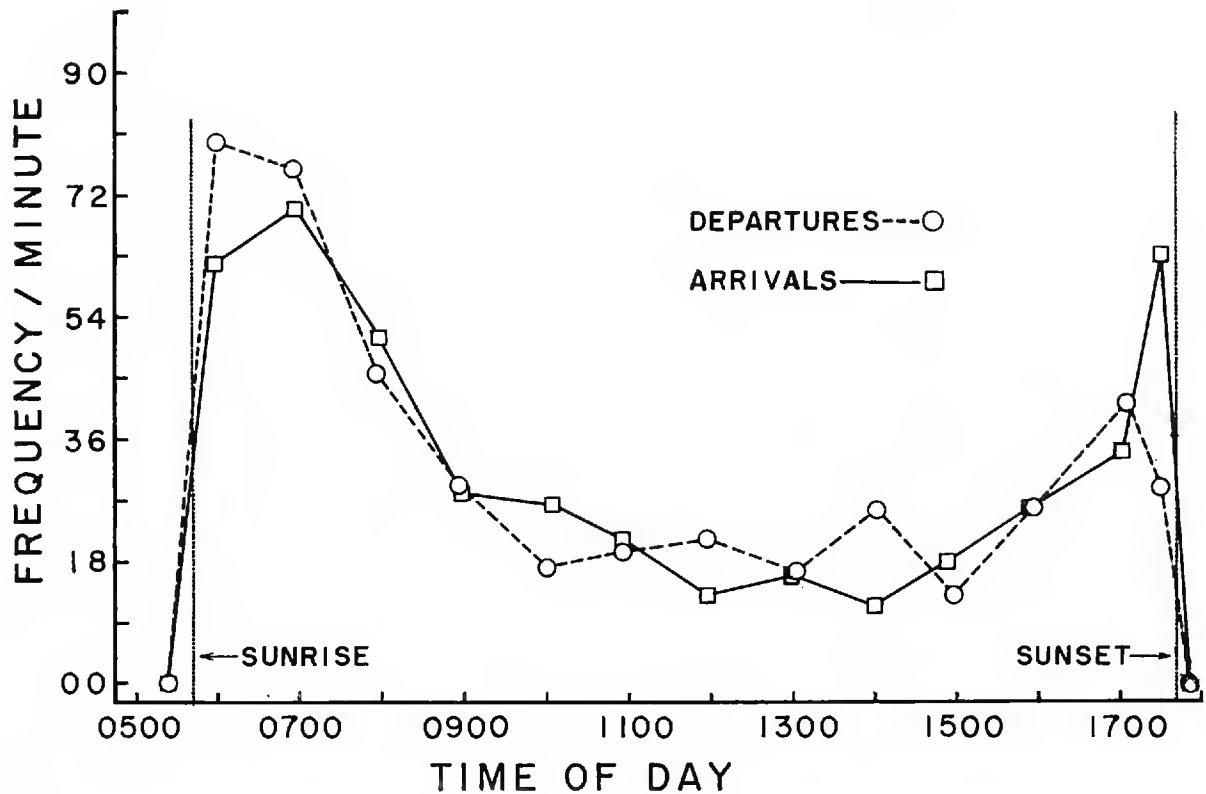


FIG. 1. Diurnal activity pattern of *Trigona fulviventris* leaving and returning to a nest on the Osa Peninsula, Puntarenas Province, Costa Rica, on 10 March 1969.

which time departures fell from about 80/min to about 20/min (Fig. 1). The lower activity level was maintained until after 1500, when activity began to rise to a second peak of about 40 departures/min at 1700. Beyond this time departure rate decreased rapidly, and arrival rate increased, until by 1750 (sunset, 1741) all departure and arrival activity had ceased.

Pollen carrying activity was greatest in the early morning hours, when an estimated 50% of the returnees carried pollen. Only an occasional bee returned with pollen in the afternoon.

The flight of *T. fulviventris* was very rapid and direct in leaving and returning to the nest tube. At other times, however, individuals could be found hovering low over the ground, occasionally alighting, usually around tree bases or stumps. Bees were also observed to hover near feeders at times, while not alighting on the feeding boards. Hovering of *T. fulviventris* was noticed at all times of day, and was usually the only activity noticed in bees of this species found away from the study nest. No stingless bee species other than *T. fulviventris* was observed hovering in such a manner, although at least three other species were commonly seen in the study area.

Trigona fulviventris failed to forage at any of the several feeding stations established around the study nest from 8 to 10 March. In

separate observations made on 7 March, however, in an area approximately 300 m upstream from the nest site, *T. fulviventris* foraged in small numbers at three feeding stations similar to the ones used in the study. As many as three individuals were seen at one time on a feeder. It was not known whether or not these individuals originated from the observed nest.

All observations of *T. fulviventris* were made during fair weather under non-overcast skies.

DISCUSSION.—The absence of *T. fulviventris* at honey-baited feeding stations at varying distances from the study nest is surprising considering that the species visits many different kinds of flowers (Schwarz, 1948, p. 333) and makes honey. The situation seems all the more strange because some feeding stations treated on 7 March similarly to those around the study nest, but placed in a different part of the forest, attracted a small number of *T. fulviventris* within a few hours. Possibly individuals of *T. fulviventris* from a given nest do not establish at food sources near to that nest. This possibility is supported by Michener (1946, p. 181) who states "At old Panama *T. fulviventris* was never seen visiting flowers of herbaceous plants growing near its nest although these same plants were visited regularly by *T. jaty* and *T. nigra paupera*."

Observations on 11 March indicated that *T. fulviventris* began to leave the nest naturally under light intensities so low that departures could not be detected without a flashlight. How the bees could navigate at these times, when visual cues were apparently unavailable, and before scent trails could have been laid for that day, is unknown.

Early flight activity appears to be characteristic of other *Trigona* species. Schlising (1970) for example, studied morning foraging of bees on four species of plants in three different areas in Costa Rica during the dry season. At each site *Trigona* bees, foraging in large numbers on two plant species, were the earliest bees to arrive after it was light. Only bees of the genus *Ptiloglossa* (Colletidae), which often foraged before light, were earlier. Schwarz (1948, p. 83) cites instances of a *Trigona* species of the subgenus *Partamona* being active before sunrise, although he states that this activity might have resulted from disturbance of the nest. Peckolt (1894) found that in Brazil the stingless bees *Trigona jaty*, *T. bipunctata*, and *T. mosquito* (all reported as *Melipona*) showed first foraging activity respectively at about 0700, 0700, and between 0530 and 0600 during good weather. In rainy weather, however, *T. mosquito* did not appear until about 0800, and this species and *T. jaty* were not seen to initiate foraging at all during thunderstorms.

By contrast von Ihering (1903) reported that *T. schrottkyi* Friese, occurring in Brazil, did not open its nest entrance until between 0800 and 1000, even in fair weather. Additionally Lutz (1931) cites eight first flights for *T. (Plebeia) mosquito* variety *domiciliorum* Schwarz on Barro Colorado Island, Canal Zone, all of which occurred relatively late in the morning. Lutz concluded that opening of the nest and initiation of foraging activity occur in response to both light conditions and to a circadian clock mechanism. The observations of Lutz were made in November and December; near the end of the rainy season in the canal zone. This condition perhaps explains the apparent contradiction between his observations for *T. mosquito* and those of Peckolt, who worked in the dry season in Brazil.

The activity pattern recorded in the present study for *T. fulviventris* (Peak activity in the mornings and evenings; moderate activity at midday) is similar to activity patterns observed by Peckolt (1894) for two stingless bee species which he identified as *T. mosquito* and *T. bipunctata*. However, foraging activity reportedly lasted only until about 1500 or 1600, normally, for those bees; not until nearly dusk as was the situation with *T. fulviventris* in the present study.

A different foraging pattern is reported by Peckolt for *T. jatay*, and Ducke (1901) for *T. fuscipennis* Friese (later considered to be *T. cupira* F. Smith) and for *T. (Plebeia) goeldiana* Friese. These species were observed to do the majority of their foraging from early morning until about noon, to cease flight activity during the heat of midafternoon, and to once again initiate foraging toward evening. Peckolt observed the latter flight period of *T. jatay* to last from about 1500 until about 1800.

The nest of *T. fulviventris fulviventris* in the present study seems similar in structure and location to those described for *T. fulviventris fulviventris* by Michener (1946, p. 189). There was no association with a termite nest, as has been reported for the subspecies *guianae*. Similar to the experience of Michener (1946) in studying the species in Panama, *T. fulviventris* in the present study were very gentle and not easily excitable, continuing apparently normal activity during close and prolonged observation at the nest site. Threat of attack was not observed.

SUMMARY.—Observations were made at and around a nest of *Trigona fulviventris* from 8 through 12 March 1969, on the Osa Peninsula, Puntarenas Province, Costa Rica. Foraging activity of *T. fulviventris* began before light, declined in intensity throughout the morning hours to a stable level maintained through midday, and then increased to a

second peak before dark. Foraging ended abruptly after the evening activity peak. The foraging pattern of *T. fulviventris* in the present study is similar to that of some other *Trigona* species, but still other *Trigona* species terminate foraging completely during midday. Early foraging activity appears to be characteristic of many species of *Trigona*, including *T. fulviventris*, but this behavior apparently is altered by inclement weather in some species, and at least one species, *T. schrottkyi*, characteristically opens its nest tube late in the morning, even in fair weather.

Trigona fulviventris failed to forage at feeders baited with honey solution and placed at varying distances and directions from the nest. Failure in the species to forage near to the nest is also reported by Schwarz (1948). A unique "hovering" flight, not seen in other *Trigona* species in the study area, was observed for *T. fulviventris*.

ACKNOWLEDGEMENTS.—Critical evaluation of this manuscript by Drs. Robbin Thorp, Norman Gary, and William Hamilton III is gratefully acknowledged. I am also indebted to Dr. Alvaro Wille, Universidad de Costa Rica, for identification of specimens. The present study was conducted while attending the Organization of Tropical Studies fundamentals course in Costa Rica.

LITERATURE CITED

- DUCKE, A. 1901. Beobachtungen über Blütenbesuch Ershcenungzeit. u.s.w. der bei Paravorkommenden Bienen. Z. Syst. Hymenopt. Dipt., 1: 25–32, 49–67.
- IHERING, H. VON. 1903. Biologie der stach ellosen Honigbienen Brasiliens. Zool. Jahrb., Abt. Syst. Oekol. Geogr. Tiere, 19: 179–287.
- LUTZ, F. E. 1931. Light as a factor in controlling the start of daily activity of a wren and stingless bees. Amer. Mus. Novitates, No. 468: 1–9.
- MICHENER, C. D. 1946. Notes on the habits of some panamanian stingless bees (Hymenoptera, Apidae). J. N. Y. Entomol. Soc., 54: 179–261.
- PECKOLT, T. 1894. Über brasilianische Bienen. Die Natur (Halle), 43: 87–91.
- SCHLISING, R. A. 1970. Sequence and timing of bee foraging in flowers of *Ipomoea* and *Aniseila* (Convolvulaceae). Ecology, 51: 1061–1067.
- SCHWARZ, H. F. 1948. Stingless bees (Meliponidae) of the Western Hemisphere. Bull. Amer. Mus. Natur. Hist., 90: 1–546.

EDITORIAL NOTICE

The editorship of the *Pan-Pacific Entomologist* will change hands beginning with the July 1973 issue (Vol. 49, No. 3). New manuscripts should be submitted to Dr. John Doyen, Division of Entomology, University of California, Berkeley, California 94720.

Behavior of the Male *Trypoxylon rubrocinctum*

(Hymenoptera: Sphecidae)

MARGARET MARY PAETZEL

5031 Donaldson Road, Grants Pass, Oregon 97526

The following observations on male *Trypoxylon* behavior were made five miles north of Grants Pass, Oregon, at 1,150 ft. elevation. The nests were in 6.4 mm holes bored in several old posts set up on the north side of a building. Notes were taken during approximately thirty hours of observation over a period of two years; July and August 1968 and 1971. Seven nests were studied, two in 1968, five in 1971. In each case the males were actively helping the females. Identification of specimens was made by Mr. Robert Every of Oregon State University, Corvallis, Oregon.

That, in some species, the male *Trypoxylon* guards the nest and occasionally helps the female has been known since the original work of the Peckhams in 1898. However, knowledge of the behavior of the male, other than his guard duty, is fragmentary, and the object of my studies was to determine the actions of the male from the beginning of a nest, through provisioning and partition building, to final closure.

This was accomplished by the use of a magnifying glass wired to the post four inches from the boring under study. Observation of activity within the nest was facilitated by the use of a 4× hand lens and a flashlight held to throw a beam of light into the interior. While working, both inside and outside of the nest, the wasps were remarkably tolerant of these arrangements, and after a short time of adjustment, proceeded with their work in a normal manner.

Beginning and Provisioning of the Nest.—In contrast to the males studied by the Peckhams (1895) I found three males helping the females clean out the borings before storage of prey. Both wasps worked at the back of the tunnel and seemed to be smoothing the walls with their mandibles, working together from side to side. Occasionally one or the other would come to the entrance and drop a load of fine sawdust outside. After an hour or so of this preparation the female would fly off to hunt while the male remained in the nest. With only one exception, the males constantly guarded the doorway while their mates were absent (Fig. 1). Also, with this same exception, the males guarded the nest entrance at night. In three nests, during early provisioning when there was much space in the boring, the female remained in the nest with the male all night.

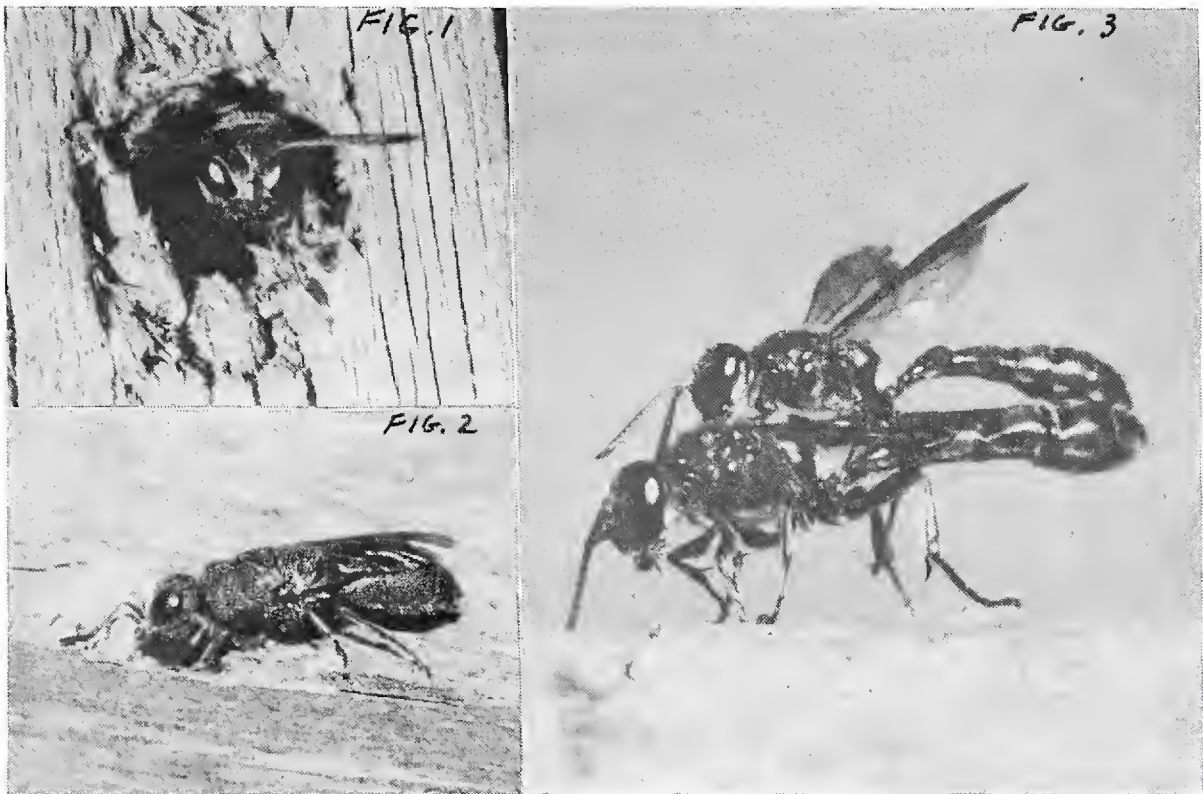


FIG. 1. Male *Trypoxylon* guarding his nest. FIG. 2. A cuckoo wasp breaking into nest of *Trypoxylon*. This nest was tightly sealed with hard clay, but note the large hole the parasite has already made. FIG. 3. Pair of *Trypoxylon* wasps mating at nest entrance.

All males studied exhibited a challenging attitude upon the approach of the female with prey, but after identifying her, their actions varied somewhat while allowing her to enter the nest. Some backed down the tunnel when there was room to do so, while others came outside and rode in on the female's back. One individual came out, slipped beneath the female as she entered, seized the spider, placed it in the cell, doubled himself in half and returned to the entrance facing outward.

Two pairs had a very distinctive ritual of recognition on the return of the female. Before allowing her to enter, the male grasped each of her antennae in his mandibles and stroked it with a cleaning motion, then with much head bobbing on the part of both, he permitted her to enter. The other pairs performed their greetings more after the manner of the wasps mentioned by Rau (1928)—merely touching antennae and nodding heads briefly at the entrance.

From the beginning the males appeared motivated to participate in storing the prey, but in four of the nests the female was sometimes reluctant to drop the spider and often a wrestling contest ensued. This contending for the prey started at the entrance and continued the length of the tunnel. However, as storing of the nests progressed, and under

pressure of work, all but one of the females eventually allowed the males to participate, often dropping the prey inside the door and leaving the male to arrange it as he pleased.

Three females, even at the onset of provisioning, allowed the males to take the prey at the entrance, two willingly giving up the spider when the male reached outside and took it from them. These were the three pairs that exhibited the most cooperation throughout, and whose males appeared the most skilled in helping their mates. But in all these nests there were periods when the female reversed her cooperative behavior, and for a time refused to allow the male to handle the prey. This seemed to occur after she had been out hunting longer than usual. Then as she began bringing in prey at more frequent intervals (15 to 20 minutes) she again relinquished the prey to the male.

All the males who helped their mates store prey worked in the same manner. At first, when there was plenty of room, they merely placed the spider at the back of the boring and shoved it lightly into place with the head, turned around, (usually inside) and began cleaning face and antennae. Later when the provisions were closer to the entrance, after a few ramming motions with the head, they would turn around outside, back in and shove and push the bulky prey into place with the feet or tip of abdomen—some even hooking their legs over the outside edge of the boring to obtain greater leverage.

The Partition.—After a sufficient number of spiders (from 5 to 15) had been put away and an egg laid, usually on the last (Krombein, 1956), the female brought in mud and made a partition to seal off the cell. All my observations agree with Hartman (1905) that the mud partitions and outer barriers are started from the bottom up. In three of the nests the males appeared to be helping the female in trowelling the mud for this inner wall. Both wasps stood together, rotating in unison, as they worked from side to side spreading the wet clay. The wings of both vibrated rapidly and each emitted a high pitched buzzing sound while working. The males who did not participate in this activity merely moved to the front of the boring and allowed the female to place the mud unhindered. One male seemed particularly stubborn about moving aside, and his female had difficulty building her partitions.

Parasites.—The wasps had few parasites, but one or two females of the brilliant metallic green cuckoo wasps (Chrysididae) were always hanging about inspecting empty borings, and warily eyeing the males guarding their doorways. Medler (1967) suggests that the presence of *Chrysis* and others in a nest may be due to inadequate protection by the male *Trypoxylon*. However, on several occasions I observed a

prowling *Chrysis* wasp attempt to enter a boring when the male was back in the tunnel, only to come out immediately, to all appearances greatly agitated, pursued by the alert guard. If there was much activity about a nest, or if the guard was sitting at the entrance where he could be seen the parasites never attempted to enter, but they seemed to take a great deal of interest in the closed borings. One afternoon I watched one of these wasps gnawing at the closed and hardened mud door of a *Trypoxylon* nest until it had succeeded in cutting through into the vestibular cell where it immediately began working at the inner partition (Fig. 2). Systematically, in the days to follow, it worked at one nest after another until I put adhesive tape over all the completed borings to protect them from being ruined.

The Last Cell.—While the female was building her cells deep within the nest I was unable to observe egg laying, but as the last cell was provisioned both wasps were unable to completely enter the boring, and they were close enough to the entrance to be seen easily. On four occasions, involving two nests, I was able to see the mating and the actions of both wasps as the female deposited an egg on the last spider brought in. After arranging the prey, the wasps took up positions facing each other, one inside, the other outside the nest. After much head bobbing, antennae waving and mandible clashing, the wasp inside came out and they mated while clinging to the post an inch or so from the entrance to the nest (Fig. 3). At once the female backed into the nest, head, front feet and thorax outside, and remained perfectly still. From time to time there was a slight quivering and tensing of the antennae. Three times the male waited, rigidly alert, watching the female. One male, when the female's antennae began to vibrate, became quite agitated and reared up on four legs, holding the bent first legs up under his head. So absorbed was he that I was able to approach within inches and make a number of pencil sketches of his unusual attitude.

Closure of the Nest.—All the *Trypoxylon* pairs observed closing nests (five out of seven) made an inner door, leaving a vestibular cell between the last occupied cell and the outer barrier. Two of the males left after the final cell was provisioned, and before the entrance was sealed, but three of the more attentive stayed with the females until the closing, though they were forced to rest on the post beside the entrance. One persistent male spent the last night resting in the vestibular cell, and halfway out of the nest when darkness came before the female finished the closure.

None of the males who remained until the nest was finished attempted to help the female with building of the mud barrier, though they had

seemed to be assisting with the inner partitions. While not actively participating, these males appeared intensely interested when the female began making the vestibular cell wall, and hovered protectively over her as she worked. The attentive one mentioned above stood with a leg over the female's back as he appeared to be trying to watch the work in progress.

In general, it seemed that the more attentive and helpful the male, the longer he stayed with the nest. The males from nests where there was little cooperation between the pair were the ones who left early, often before the female began making the inner door. The one male of all the nests studied who stayed until the last mud pellet was spread on the final barrier, and who even came back several times with the female to inspect the closed nest, was the one who had been allowed by the female to share most in the work.

The last nest was provisioned and sealed on 13 August, and from that time I saw no more females although the males continued to fly about until 28 August. Every night several males rested in the empty borings until that date, when the weather turned unusually cold, then they disappeared from their old haunts, nor were they to be found on the asters or Michaelmas daisies of the garden.

LITERATURE CITED

- HARTMAN, C. 1905. Observations on the habits of some solitary wasps of Texas. Univ. Tex. Bull. No. 65, Sci. Series No. 7. 72 p.
- KROMBEIN, K. V. 1956. Proc. Ent. Soc. Wash. 58. No. 3: 155-156.
- MEDLER, J. T. 1967. Biology of *Trypoxylon* in trap nests in Wisconsin. Amer. Midland Natur., 78: 344-358.
- PECKHAM, G. W. AND E. G. PECKHAM. 1895. Notes on the habits of *Trypoxylon rubrocinctum* and *Trypoxylon albopilosum*. Psyche, 7: 303-306.
1898. On the instincts and habits of solitary wasps. Wis. Geol. Natur. Hist. Surv. Bull. No. 2. 245 p.
- RAU, P. 1928. Field studies in the behavior of the non-social wasps. Trans. Acad. Sci. St. Louis, 25: 489 p.

A Revision of the New World Genus *Formicilla*¹

(Coleoptera: Anthicidae)

DONALD S. CHANDLER

University of Arizona, Tucson 85721

The genus *Formicilla*, designated for *F. munda* LeConte, is now distinct due to the removal of most of the neotropical species which had accumulated in the genus to the *leporinus*- and *scitulus*-groups of *Acanthinus* (Werner 1960, 1970). Beal (1950) had defined the genus for the United States. However, due to the removal by Werner of two species included in Beal's paper and the anatomical similarities of the remaining United States species, the need for more study of the relationships within the genus was indicated.

Formicilla is here defined as those New World Anthicidae with mesosternum expanded laterally; a tuft of long curved setae on inner margin of mesepisterna reaching humeral angle; pronotum deeply constricted in basal half; surface polished, with little pubescence; long, tactile setae; right mandible with single to triple tooth in middle of cutting edge; last segment of maxillary palpi securiform; simple tegmen of aedeagus.

The species of *Formicilla* are here separated into two groups with the *bruchi*-group containing a single species, *F. bruchi* Pic, and the *munda*-group containing the remaining. The *bruchi*-group is distinct in having a deep depression on the dorsum of the pronotum and in having the gonopore armature separated into two lateral sclerites and a biarmed sclerite. The *munda*-group is characterized by having a shallow depression or no depression on the dorsum of the pronotum and the gonopore armature consisting of a biarmed sclerite.

Both external and genitalic characters were used in defining species. The tegmina of the various species are very similar, but differences in the gonopore armature were noted and can be used for identification. The gonopore armature is best seen when the genitalia are withdrawn and cleared in KOH and then examined with a compound microscope. For best viewing the internal sac should be teased free of the phallobase so that it can be viewed from all angles. The internal sac in all species has an area of small, anteriorly projecting spines completely encircling it. The aedeagus is bilaterally symmetrical.

The populations of *Formicilla munda* in the United States vary in color, which resulted in the species *F. gilensis* and *F. evanescens* being

¹ University of Arizona Agricultural Experiment Station Journal Series #2024.

designated by Casey. The main difference was that *F. munda* and *F. evanescens* were relatively light in color while the intervening *F. gilensis* was darker. More extensive collecting has revealed that light populations occur in Texas, along the lower Colorado River, the San Joaquin Valley of California and in Nayarit, Mexico. Dark populations occur in the Sacramento Valley of California, from Arizona to Sinaloa, Mexico and in Morelos, Mexico. Areas of intergradation of color were found in all cases. Examination of the gonopore armature of specimens from all populations revealed they are similar and distinct from all other species. The anatomical similarities and the devaluation of color led me to conclude that the names *gilensis* and *evanescens* should be treated as synonyms of *F. munda*.

The holotypes are to be deposited in the California Academy of Sciences.

I would like to thank Dr. Floyd Werner for his help and encouragement in the preparation of this paper.

KEY TO THE SPECIES OF FORMICILLA

1. Dorsum of pronotum with deep depression at area of constriction (Fig. 1a); pubescence elevated at 30 degree angle or greater; gonopore armature with lateral sclerites separated from biarmed sclerite. Northeastern Argentina. (*bruchi*-group) *bruchi* Pic
- Dorsum of pronotum with shallow or no depression at area of constriction (Fig. 1b); pubescence variable; gonopore armature consisting of biarmed sclerite (*munda*-group) 2
2. Pubescence on flanks of elytra approximately two-thirds as long as tactile setae, elevated at 30 degree angle. Westcentral Mexico *longipilosa* Chandler n. sp.
- Pubescence on flanks of elytra appressed to elevated at 30 degree angle, but always distinctly less than half the length of tactile setae 3
3. Pubescence appressed, short; elytral postbasal transverse impression indistinct (Fig. 2b). Venezuela to Argentina *grandiceps* Pic
- Pubescence raised from surface at 10 to 30 degree angle; elytral postbasal transverse impression distinct in lateral view (Fig. 2a) 4
4. Elytral markings in form of spots, posterior marking small; gonopore armature thick in lateral view and with broad projections (Fig. 6). Central to Northcentral Mexico *vitrea* Chandler n. sp.
- Elytral markings in form of complete bands across elytra; gonopore armature narrow in lateral view (Figs. 5, 8) 5
5. Eyes large, round except truncate at base of mandibles (Fig. 3a); gonopore armature in lateral view with no projections visible. Michoacan, Mexico *alta* Chandler n. sp.
- Eyes smaller, round to oval (Fig. 3b); gonopore armature with distinct projections in lateral view. Central Mexico to California and Texas *munda* LeConte

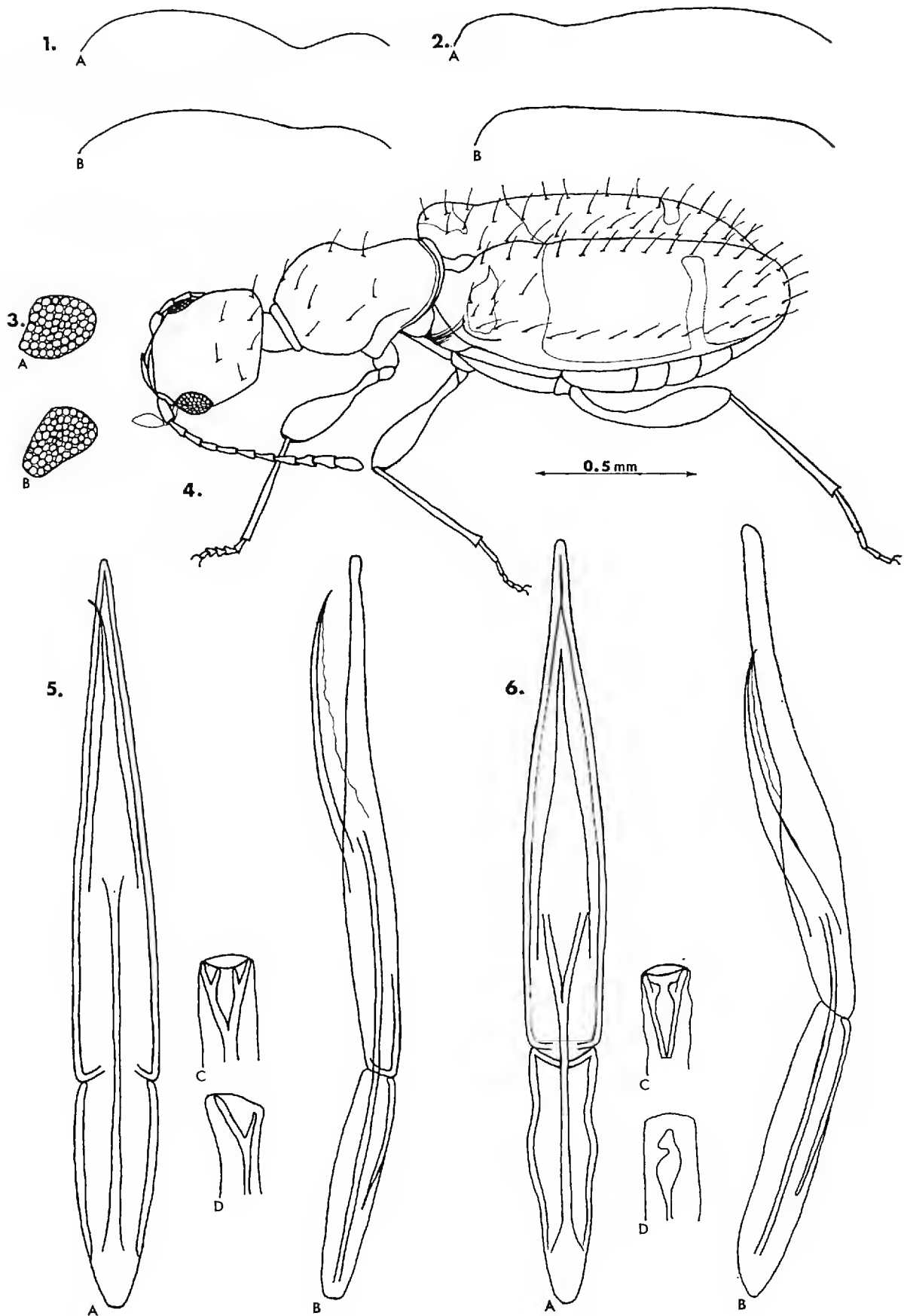


FIG. 1. Lateral view pronotum of: a. *F. bruchi*; b. *F. munda*. FIG. 2. Lateral view elytra: a. *F. munda*; b. *F. grandiceps*. FIG. 3. Eye of: a. *F. alta*; b. *F. munda*. FIG. 4. Lateral view *F. munda*. FIGS. 5-6. Genitalia: a. ventral view, b. lateral view; gonopore armature: c. ventral view, d. lateral view. FIG. 5. *F. munda*. FIG. 6. *F. vitrea*.

FORMICILLA BRUCHI Pic

(Figs. 1a, 10)

Formicilla Bruchi [sic] Pic 1904, 329 (Type loc.: Prov. Buenos Aires, Argentina); 1911, 22. Bruch 1917, 463; 1928, 193.

Formicilla bruchi, Werner 1965, 3, 11.

Polished and sparsely punctate, head and pronotum castaneous with appendages of similar color, elytra fuscous with luteous marking on area of postbasal transverse impression of each elytron, sometimes with lighter area around scutellum but not reaching elytral markings.

MALE.—Llavalol, Argentina: 2.61 mm long, head rounded at base, width behind eyes 0.44 mm, width at antennal insertions 0.28 mm, length 0.60 mm, eyes oval, broadest dorsally 0.10×0.13 mm, antennae moderately pubescent, segments II–IV narrow, VI–XI gradually increasing in width; head very sparsely pubescent, with few tactile setae.

Pronotum polished, sparsely pubescent with few tactile setae, pubescence appressed, pronotum deeply constricted in basal half, with saddle-like depression on dorsum, pronotal length 0.69 mm, width at base 0.30 mm, width at constriction 0.19 mm, distance from base to constriction 0.20, greatest width 0.42 mm at 0.47 mm from base.

Elytra polished with distinct pubescence at 30 degree angle or greater, length 0.08 mm, tactile setae length 0.16 mm, length of elytra 1.32 mm, width at humeri 0.60 mm, greatest width 0.77 mm at 0.51 mm from base, marking 0.20 mm from base, 0.11 mm long, elytral depression indistinct in lateral view.

Mesepisternal setae reaching humeral angle, length 0.14 mm, profemur swollen, length 0.41 mm, width 0.13 mm; protibia slender, length 0.43 mm; mesofemur swollen in distal two-thirds, length 0.47 mm, width 0.12 mm; mesotibia length 0.42 mm, metafemur swollen in distal one-half, length 0.61 mm, width 0.12 mm, metatibia length 0.58 mm.

Gonopore armature with a biarmed sclerite with very short stem, an additional sclerite projects anteriorly from distal portion of each arm, reaching mouth of primary gonopore. In lateral view biarmed sclerite curved, lateral sclerite straight.

FEMALE.—Similar to male.

DISTRIBUTION.—Northeastern Argentina in Buenos Aires Province; one doubtful record from Chile in the Bowditch Collection (Harvard).

ARGENTINA: *Buenos Aires*: Llavalol, 1906, R. Thaxter; vic. La Plata, 2 January 1963, F. G. Werner; Prov. Buenos Aires, 26 August 1917, C. Bruch. CHILE: Chi., F. C. Bowditch Collection.

FORMICILLA GRANDICEPS Pic

(Figs. 2b, 7)

Formicilla grandiceps Pic 1913, 130 (Type-loc.: Chaco du Paraguay). Bruch 1928, 192–193.

Formicilla Garciaei [sic] Pic 1948, 15–16 (Type-loc.: Buenos Ayres, Argentina).

NEW SYNONYMY.

Formicilla garciaei, Werner 1965, 4, 8.

Length 1.80–2.00 mm, polished, sparsely punctate, head and pronotum castaneous, elytra slightly darker with two luteous markings on each elytron, both markings sometimes reaching sides but only anterior markings may meet at elytral suture, anterior marking in elytral depression.

MALE.—Salobra, Brazil: length 1.84 mm, head subtruncate at base, length of head 0.42 mm, width behind eyes 0.33 mm, width at antennal bases 0.17 mm, eyes oval, broadest dorsally 0.07×0.08 mm, antennae moderately pubescent, antennal segments II–IV slender, V–XI slowly increasing in width; head very sparsely pubescent and with few tactile setae.

Pronotum constricted in basal half, very shallow depression on dorsum, sparsely setate and pubescent, pubescence appressed, length of pronotum 0.45 mm, width of constriction 0.15 mm, distance from base to constriction 0.10 mm, greatest width 0.28 mm at 0.29 mm from base, width at base 0.21 mm.

Elytra polished with numerous tactile setae and with pubescence decumbent, length of pubescence 0.04 mm, length of tactile setae 0.12 mm, length of elytra 0.97 mm, width at humeri 0.42 mm, greatest width 0.58 mm at 0.46 mm from base, elytral depression indistinct.

Metepisternal setae reaching humeral angle, 0.05 mm long, profemur swollen, length 0.33 mm, width 0.12 mm, protibia slightly dilated to apex; 0.24 mm long, mesofemur swollen in distal two-thirds, 0.34 mm long, width 0.08 mm; mesotibia slender, 0.29 mm long, metafemur swollen in distal one-half, length 0.33 mm, width 0.07 mm, metatibia 0.39 mm long.

Gonopore armature with tips broadened, in lateral view curved and appearing spoon-shaped.

FEMALE.—Similar to male, but longer.

This species is most similar to *F. longipilosa* because of the shallow pronotal depression and the indistinct elytral depression.

DISTRIBUTION.—From northern Argentina and southcentral Brazil through the higher lands of the Amazon drainage to Venezuela.

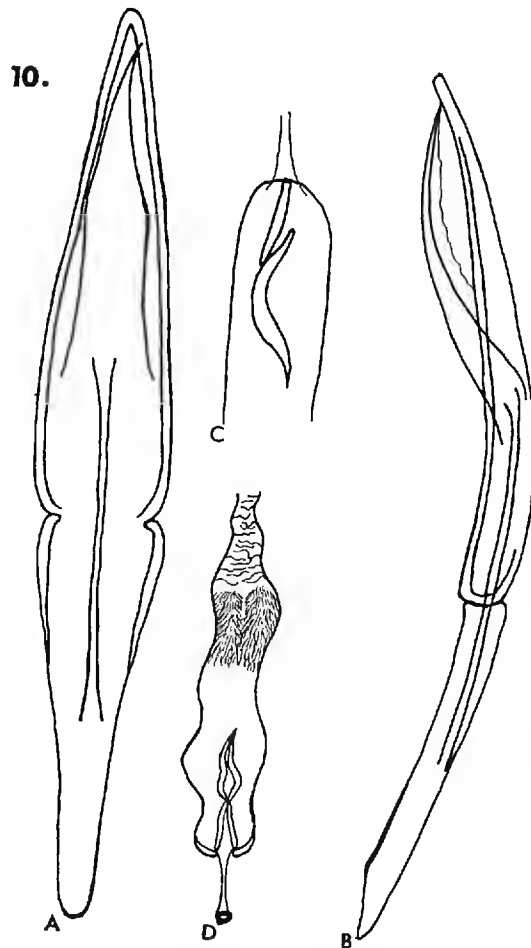
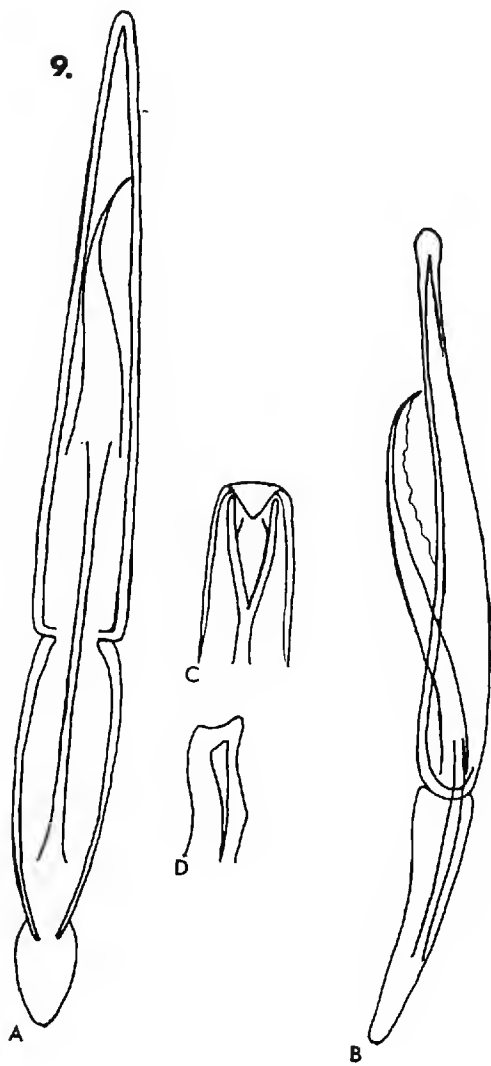
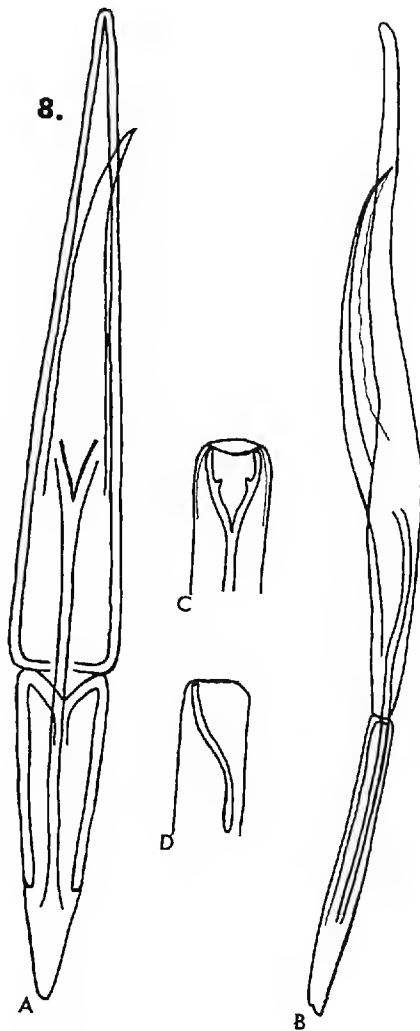
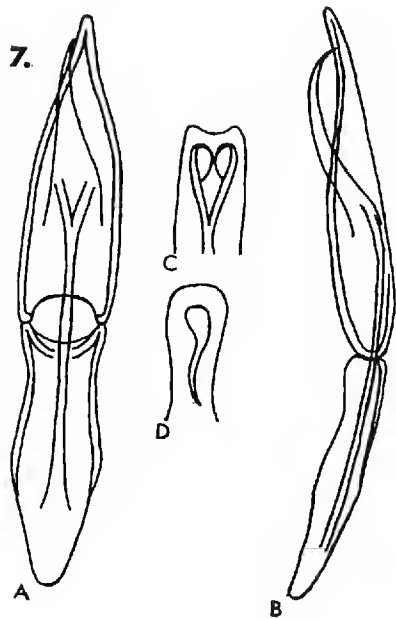
ARGENTINA: *Misiones*: Iguazú, 20 January/13 March 1945, Hayward, Willink, Golbach. BOLIVIA: *Sta. Cruz*: El Cidral, ca. 100 km. NNW Sta. Cruz, 450 m., UV lt. trap, January 1962, R. Golbach. BRAZIL: *Mato Grosso*: Salobra, January 1955, P. Pereira; Xingu National Park, Jacaré, November 1961, M. Alvarenga, W. Bokermann; Cuyaba. VENEZUELA: *Miranda*: Agua Fria, El Jacillo, 14 July 1964, 1500777, C. J. Rosales, P. J. Salinas. *Portuguesa*: Guanaré, 10/13 September 1957, Borys Malkin.

***Formicilla longipilosa* Chandler new species**

(Fig. 9)

Polished, sparsely punctate, head and pronotum testaceous, elytra same color with humeri and two markings on each elytron brown, markings oval, not reaching flanks of elytron, posterior markings joining at elytral suture, appendages similar in color to pronotum.

HOLOTYPE MALE.—Length 2.12 mm, head evenly rounded when viewed in plane from base to apex, width behind eyes 0.34 mm, width at antennal insertions 0.19 mm, length 0.49 mm, eyes rounded, truncate toward base of antennae, broadest dorsally 0.11×0.12 mm. Antennal segments moderately pubescent, pubescence



increasing distally, segments II–V narrow, VI–XI gradually increasing in width, head very sparsely pubescent and with few tactile setae.

Pronotum polished, with both sparse pubescence and tactile setae, deeply constricted in basal half, dorsum almost level, length 0.57 mm, width at base 0.25 mm, width at constriction 0.22 mm, length from constriction to base 0.16 mm, greatest width 0.33 mm at 0.38 mm from base.

Elytra polished with distinct pubescence and numerous tactile setae, pubescence at 30 degree angle from elytra, longest along flanks 0.09 mm, tactile setae length 0.12 mm, row of distinct punctures adjacent to and paralleling elytral suture, indistinct elytral depression, length of elytra 1.12 mm, width at humeri 0.45 mm, greatest width 0.60 mm at 0.41 mm from base, first marking 0.30 mm from base, 0.21 mm long, second marking 0.70 mm from base and is 0.19 mm long.

Mesepisternal setae not reaching humeral angle, length 0.10 mm, profemur swollen, length 0.30 mm, width 0.08 mm, tibia slender, length 0.33 mm; mesofemur swollen in distal two-thirds, length 0.41 mm, width 0.07 mm, mesotibia length 0.34 mm, metafemur swollen in distal one-half, length 0.52 mm, width 0.08 mm, metatibia straight, length 0.04 mm.

Gonopore armature narrow with indistinct projections, no widened areas, in lateral view, a narrow triangle.

FEMALE.—Similar to male, but with mesepisternal setae reaching humeral angle, head subtruncate. Females in type series are slightly shorter than the male, 1.98–2.07 mm.

This species is most similar to *F. grandiceps* by its indistinct elytral depression and very shallow depression on the dorsum of the pronotum. However, the gonopore armature is most similar to that of *F. alta*, not broadened anteriorly as in *F. grandiceps*.

Holotype male, CHILPANCINGO, GUERRERO, MEXICO, D. M. DeLong, 1941, at light. Paratypes: 3 females, eutopotypical.

FORMICILLA MUNDA LeConte

(Figs. 1b, 2a, 3b, 4, 5, 11)

Formicilla munda LeConte 1851, 152–153 (Type loc.: on lower part of Colorado River). Casey 1895, 646. Pic 1911, 22. Beal 1950, 126.

Anthicus [*Formicomus*, *Formicilla*] *mundus*, LeConte 1852, 95.

Formicilla evanescens Casey 1895, 646–647 (Type loc.: Austin, Texas). Pic 1911, 22. Beal 1950, 128–129 (*Formicilla scitula evanescens* in part). NEW SYNONYMY.

Formicilla gilensis Casey 1895, 647 (Type loc.: Tucson, Arizona). Pic 1911, 22. Beal 1950, 125–126. NEW SYNONYMY.

←

FIGS. 7–9. Genitalia: a. ventral view, b. lateral view; gonopore armature: c. ventral view, d. lateral view. FIG. 7. *F. grandiceps*. FIG. 8. *F. alta*. FIG. 9. *F. longipilosa*. FIG. 10. *F. bruchi* genitalia: a. ventral view, b. lateral view; gonopore armature: c. lateral view; internal sac: d. ventral view.

Formicilla munda munda, Beal 1950, 126-127. NOT: *Formicilla munda gracilipes*, Beal 1950, 127-128.

Color of head and pronotum varying from luteous to fulvous, head sometimes darker than pronotum, elytral markings always luteous with elytral basement color varying from fuscopiceous to brown, light markings vary in width depending on darkness of specimen, markings wider in lighter specimens and narrower in darker specimens, markings of lighter specimens may join on elytral flanks, first marking continuous across elytra while second marking continuous only in lighter specimens. Elytral depression distinct, shape of base of head varies from subtruncate to rounded and pubescence on pronotum and elytra varies from appressed to elevated at 30 degree angle, length 1.80-2.40 mm.

MALE.—Hermosillo, Mexico: 2.31 mm long; base of head subtruncate, sparsely pubescent and setate, pubescence appressed, length of head 0.52 mm, width behind eyes 0.41 mm, width at antennal bases 0.22 mm, eyes oval, broadest dorsally 0.11 × 0.12 mm, antennal segments II-VI slender, VII-XI gradually increasing in width, antennae moderately pubescent, pubescence increasing in distal segments.

Pronotum deeply constricted in basal half, dorsum varies from slightly concave to level, sparsely setate and pubescent, pubescence depressed to elevated, length of pronotum 0.55 mm, width at constriction 0.25 mm, length from base to constriction 0.15 mm, widest anteriorly 0.42 mm at 0.39 mm from base, width at base 0.32 mm.

Elytra polished with pubescence varying from depressed to elevated at 30 degree angle, length of pubescence 0.06 mm, tactile setae length 0.12 mm, length of elytra 1.26 mm, width at humeri 0.51 mm, maximum width 0.69 mm at 0.48 mm from base, distance from base to first marking 0.13 mm, length of marking 0.13 mm, distance from base to posterior marking 0.65 mm, length 0.19 mm.

Mesepisternal setae reaching humeral angle, length 0.14 mm, profemur swollen, length 0.38 mm, width 0.11 mm, protibia 0.37 mm long; mesofemur swollen in distal two-thirds, length 0.40 mm, width 0.09 mm; mesotibia 0.41 mm long, metafemur swollen in distal one-half, length 0.56 mm, width 0.11 mm, metatibia 0.56 mm long.

Gonopore armature biarmed with median projection on each arm reaching to primary gonopore; in lateral view projections very distinct.

FEMALE.—Similar to male.

This species is most similar to *F. alta* because of the distinct elytral depression and the gonopore armature having a median projection, although the gonopore armature is slender and not so developed as in *F. alta*.

Division into subspecies has been considered for *F. munda*. However, I feel this classification would not be realistic because the different colored populations are separated into several disjunct populations (Fig. 11).

DISTRIBUTION.—This species ranges from Morelos, Mexico, through the lower elevations of Sonora and Arizona into the Central Valley of California and east to Arkansas.

UNITED STATES: *Arizona*: Apache Co.: White Mtns. Cochise Co.: Willcox. Coconino Co.: Sedona. Gila Co.: Globe, Wheatfields-nr. Globe, Roosevelt Lake. Graham Co.: Safford, Thatcher. Maricopa Co.: Buckeye, Gillespie Dam-Gila Bend, Phoenix, Wickenburg. Pima Co.: Brown Cyn.-Baboquivari Mtns., Green Valley, Picture Rock Pass and Ariz-Son. Desert Museum-Tucson Mtns., Robles Ranch, Sabino Cyn.-Sta. Catalina Mtns., Tucson, 8 mi. N. Vail. Pinal Co.: Coolidge, Superior. Santa Cruz Co.: Madera Cyn., Nogales. Yavapai Co.: Bloody Basin, Cottonwood. Yuma Co.: Dateland, Ehrenberg, Laguna Dam, Palomas, Roll, Yuma. *Arkansas*: Howard Co.: 5 mi. N. Nashville. Pike Co. *California*: Imperial Co.: "Brawleys," "Fr. Yuma," Imperial, E. shore Salton Sea. Madera Co.: Visalia. Merced Co.: 4 mi. S. Dos Palos, Merced. Riverside Co.: Cathedral City. San Bernardino Co.: 4 mi. S. Colton. San Diego Co.: La Mesa. Tehama Co.: Red Bluff, 20 mi. NW. Red Bluff, 1 mi. SE. Vina. *Colorado*: El Paso Co.: Colorado Springs. *Louisiana*: Bossier Co.: Bossier Parish. *New Mexico*: Doña Ana Co.: Las Cruces, Mesilla Park. *Oklahoma*: Texas Co.: Texahoma. *Texas*: Brazos Co.: College Station-Texas A&M. Brown Co. Comal Co.: New Braunfels. Dallas Co.: Dallas. Grayson Co.: Denison. Hidalgo Co.: Brownsville. Llano Co.: Llano. Nueces Co.: Corpus Christi. Patricio Co.: Sinton. Potter Co.: 14 mi. E. Amarillo. Terrell Co.: Sanderson. Victoria Co. MEXICO: *Baja California*: La Paz, 4 mi. N. Todos Santos. *Morelos*: 5 mi. S. Cuernavaca. *Nayarit*: Acaponeta, Ixtlan del Rio. *Sinaloa*: 6 mi. S. Culiacan, Los Mochis, Mazatlan, 26 mi. N. Pericos. *Sonora*: Alamos, Desemboque, 5 mi. N. Guaymas, Hermosillo, 40 mi. N. Hermosillo, Navajoa, Nogales.

***Formicilla alta* Chandler new species**

(Figs. 3a, 8)

Polished, sparsely pubescent, head and pronotum flavous to tawny, elytra fulvous to tawny with two castaneous markings on each elytron, both of which may or may not meet at elytral suture or extend to sides, humeri darkened, elytral depression distinct.

HOLOTYPE MALE.—Length 1.98 mm, head rounded at base, pubescence sparse and appressed, few tactile setae, length of head 0.46 mm, width behind eyes 0.33 mm, width at antennal bases 0.18 mm, eyes rounded and truncate close to mandibles 0.08 × 0.09 mm, antennae moderately pubescent, pubescence increasing distally, segments II–IV of equal width, VII–XI gradually increasing in width.

Pronotum polished, sparse pubescence appressed, few tactile setae; deeply constricted in basal half with dorsum flat, length 0.48 mm, width at base 0.26 mm, width at constriction 0.20 mm, length from base to constriction 0.14 mm, greatest width 0.32 mm at 0.33 mm from base.

Elytra polished with pubescence varying from depressed to elevated at 30 degree angle, length pubescence 0.06 mm, length tactile setae 0.12 mm, length elytra 1.04 mm, width at humeri 0.50 mm, greatest width 0.58 mm at 0.58 mm from base, first marking 0.31 mm from base and 0.27 mm long, second marking 0.72 mm from base and 0.14 mm long.

Mesepisternal setae reaching humeral angle, length 0.15 mm, profemur swollen, length 0.34 mm, width 0.11 mm, protibia 0.31 mm long; mesofemur swollen in distal two-thirds, length 0.38 mm, width 0.10 mm, mesotibia length 0.34 mm; metafemur swollen in distal half, length 0.45 mm, width 0.08 mm, metatibia length 0.43 mm.

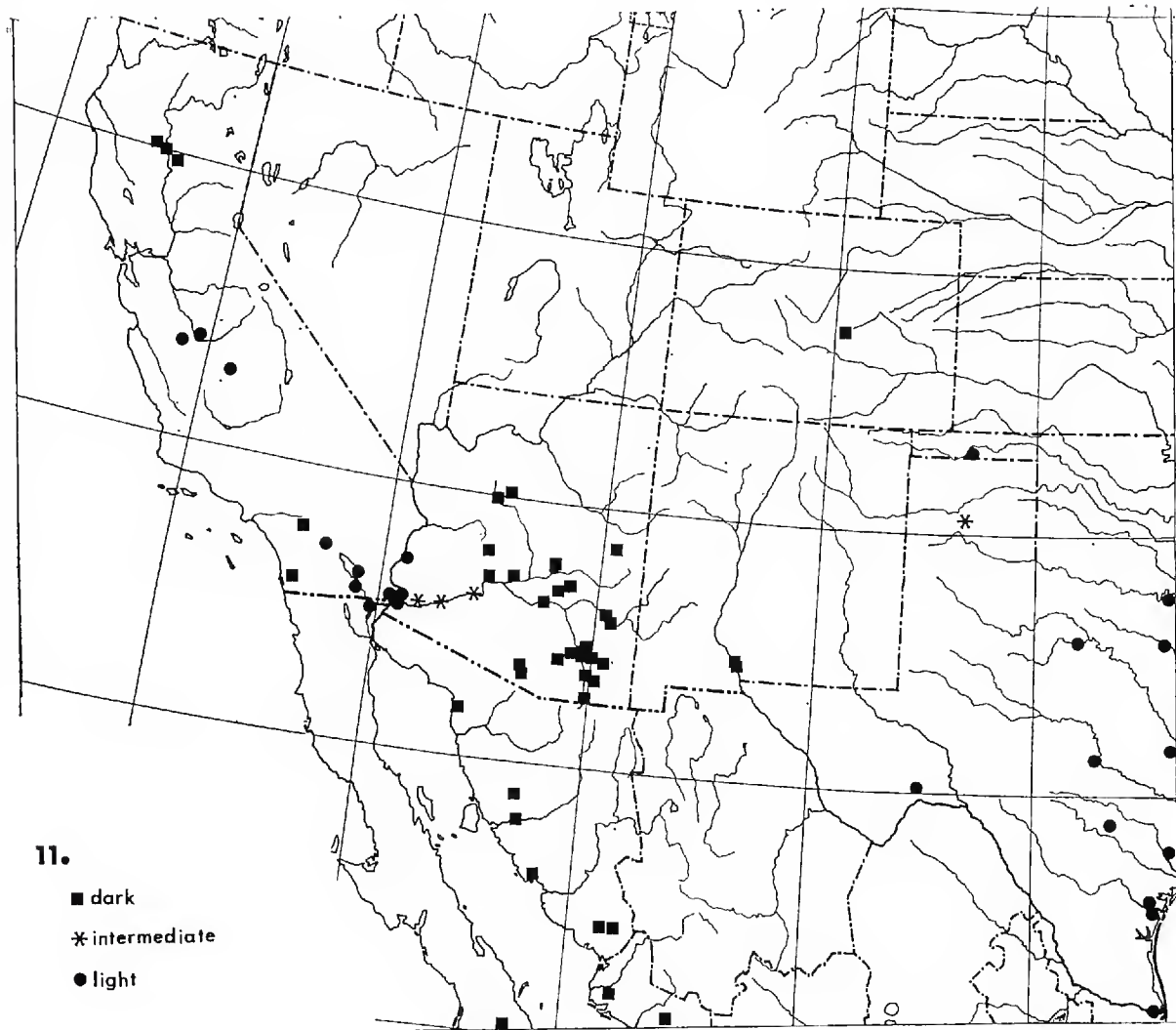


FIG. 11. Distribution of color populations of *F. munda*.

Gonopore armature slender and curved in lateral view with short, stubby projections.

FEMALE.—Not known.

The shape of the gonopore armature closely resembles that of *F. longipilosa*, but the flat pronotal dorsum and distinct elytral depression indicate close relationship to *F. vitrea*.

Holotype male, MIL CUMBRES, 30 KM. W. HIDALGO, MICHOACAN, MEXICO, (Rt. 4, Km. 244), 7,600 ft., in grass on edge of road, 29 June 1948, F. G. Werner. Paratype: 1 male, eutopotypical.

***Formicilla vitrea* Chandler new species**

(Fig. 6)

Polished, sparsely pubescent, head and pronotum castaneous, fuscopiceous elytra with two luteous markings on each elytron, first marking in elytral depression, not reaching distal edge of elytra but meeting at elytral suture, second marking smaller, sometimes meeting at elytral suture, elytral depression distinct, length varies from 1.85–2.28 mm.

HOLOTYPE MALE.—Length 2.17 mm, head subtruncate at base, pubescence sparse and appressed, few tactile setae, length of head 0.45 mm, width at antennal bases 0.20 mm, width behind eyes 0.39 mm, eyes oval, broadest dorsally 0.07×0.08 mm, antennae moderately pubescent and setate, pubescence increasing distally, segments II–V of equal width, VI–XI barely increasing in width.

Pronotum polished, sparse appressed pubescence, few tactile setae; deeply constricted in basal half with dorsum flat, length of pronotum 0.54 mm, width at base 0.28 mm, width at constriction 0.24 mm, length from base to constriction 0.14 mm, widest point 0.39 mm at 0.38 mm from base.

Elytra polished with pubescence depressed to elevated at 30 degree angle, length pubescence 0.05 mm, length tactile setae 0.12 mm, length elytra 1.18 mm, width at humeri 0.45 mm, greatest width 0.07 mm at 0.49 mm from base, first marking 0.14 mm from base and 0.08 mm in length, second marking 0.63 mm from base and 0.14 mm in length.

Mesepisternal setae reaching humeri, length 0.14 mm, profemur swollen, length 0.40 mm, width 0.13 mm, protibia slender, length 0.36 mm; mesofemur swollen in distal two-thirds, length 0.41 mm, width 0.09 mm, mesotibia 0.39 mm long; metafemur swollen in distal half, length 0.51 mm, width 0.11 mm, metatibia length 0.50 mm.

Gonopore armature thick in lateral view with large, blunt projections, very short basal arm.

FEMALE.—Similar to male.

The gonopore armature is very distinct and quite different from that of the other species. The flat pronotal dorsum indicates affinities to *F. alta*.

Holotype male, 20 km. W. LAGOS, JALISCO, MEXICO, dry agricultural area (running on damp ground among grass stems next to ditch), 6,130 ft., 2 August 1948, F. G. Werner.

PARATYPES.—13 males, 7 females, eutopotypical; 1 male, 49 mi. SE. Chihuahua, Chihuahua, MEX., 4,000 ft., light, San Pedro River, 20 July 1952, RB & BK Selander; 1 female, 16 km. W. Jalostotitlan, Jalisco, MEX., 5,920 ft., (Rt. 170), (Dry grazing area, under human dung), 1 July 1948, W. Nutting.

LITERATURE CITED

- BEAL, R. S. JR. 1950. Systematic notes on the genus *Formicilla* in the United States and Mexico. *Pan-Pac. Entomol.*, 26: 122–130.
- BRUCH, C. 1917. Nuevas capturas de insectos mirmecófilos. *Physis, Rev. Assoc. Argent. Cienc. Natur.*, 3: 458–466.
1928. Suplemento al catálogo sistemático IV, (Addenda, corrigenda, y lista de especies). *Physis, Rev. Assoc. Argent. Cienc. Natur.*, 9: 186–204.
- CASEY, T. L. 1895. Coleopterological notices, VI. *Ann. N.Y. Acad. Sci.*, 8: 435–838.
- LECONTE, J. L. 1851. Descriptions of new species of Coleoptera from California. *Ann. Lyc. Natur. Hist. N.Y.*, 5: 125–184.
1852. Synopsis of the Anthicites of the United States. *Proc. Acad. Natur. Sci. Philadelphia*, 6: 91–104.

- PERC, M. 1904. Anthicides nouveaux de la République Argentine recueillis par M. Carlos Bruch. *Rev. Mus. La Plata*, 11: 329-331.
1913. Nouveaux anthicides exotiques. *Échange*, 29: 130-132.
1948. Notes et nouveautés diverses. *Diversités Entomologiques*, 4: 12-16.
- WERNER, F. G. 1960. A redefinition of the genus *Acanthinus* as an important element in the Anthicid fauna of the neotropical region. *Verh. XI Int. Kongr. Ent.*, Wien, I: 109-112.
1965. A key to the described species of New World Anthicidae of the genus *Acanthinus* La Ferté, with new synonymy. *Pap. Avulsos Zool. São Paulo*. 18: 1-15.
1970. A revision of *Acanthinus* (Coleoptera: Anthicidae) IX. The *Leporinus*, *Scitulus*, *Cuyabanus*, and *Myrmecops*-Groups. *Ann. Entomol. Soc. Amer.*, 63: 718-731.

SCIENTIFIC NOTE

A Note on *Dacnochilus fresnoensis* (Coleoptera:Staphylinidae).—Hugh B. Leech described *Dacnochilus fresnoensis* in 1939 (*Can. Entomol.*, 71: 261) on the basis of a male collected at Fresno, California 5 June, 1931 and a female from the same locality 23 June, 1930, both by Roy S. Wagner. The species has not been mentioned in the literature since and to my knowledge until now no other specimen has been found.

Only two other species are known in this genus, the habits of the members of which are unknown. The closely related *Acalophaena* is represented by several species in Latin America one of which, *A. basalis* Lynch-Arribálzaga, was reported in 1884 by its describer from termite nests (*Bol. Acad. Nac. Cienc. Cordoba*, 7: 270).

I have received from Derham Giuliani a single male of *Dacnochilus fresnoensis* collected by him at "Riverside, California on August 16, 1971 on log with ants and termites." In reply to my request for more information about this rare find Giuliani wrote:

"Concerning the specimen of *Dacnochilus fresnoensis*, I collected it at Dr. Fisher's house when I was in Riverside last August. You were away on a trip at the time. He could show you the log and perhaps recall some details I've forgotten. I helped him move the log his wife wanted put at a spot in the garden. It contained large numbers of ants and termites. Debris with ants and termites fell off here and there during the move and it was near this that I spotted the staph walking about. I looked on the log and back at the spot it had been moved from but saw no more. Unfortunately I did not collect any of the ants or termites even though I felt certain that the staph had been among them."

Conversations with Dr. T. W. Fisher (U.C.R.) revealed that the log was one of three alder logs which had been brought to his home about two years before from Lytle Creek, San Bernardino County, California about thirty miles to the northwest of the collecting site. Visits to his place, on a chaparral-covered hill at Sunnymead, Riverside County, California, were made on 31 April and 17 June, 1972, a year of very little rainfall. No ants or termites were found on or under the three logs, two of which were still in their original position. No more *Dacnochilus* were found.—IAN MOORE, *Division of Biological Control, University of California, Riverside 92502*.

**A New Genus of Pseudoscorpions Based upon
*Atemnus hirsutus*¹**

(Pseudoscorpionida: Chernetidae)

WILLIAM B. MUCHMORE

Department of Biology, University of Rochester, Rochester, N.Y. 14627

The species *Atemnus hirsutus* was described by N. Banks in 1914 on the basis of a single individual "found 10 feet from ocean" at Laguna Beach, California. Evidently, no further specimens have been discovered, and the species has remained an enigma ever since. Beier (1932) and Roewer (1937) overlooked it completely in their worldwide reviews of the pseudoscorpions, and Hoff (1958, p. 22) only noted that "From Banks' figure, the species probably belongs to an undescribed genus in the Lamprochernetinae." Through the courtesy of Dr. H. Levi, I have borrowed the mounted holotype from the Museum of Comparative Zoology, Harvard University. I have remounted it and reexamined it in detail, and find that it belongs to an undescribed genus of the family Chernetidae.

Mucrochernes Muchmore, new genus

DIAGNOSIS.—(Based upon female only.) Surfaces generally smooth, but carapace granulate laterally and posteriorly, and palpal segments each with a few granules. Setae generally long, thin and tapering to fine point, many with single, small, sharp spinule at about the middle of the shaft. Carapace a little longer than broad; with two transverse furrows and two distinct eye spots; covered with about 200 vestitural setae. Tergites and sternites, except 11th, divided; with many setae arranged in one, two or three irregular rows; sternites 4, 5 and 6 with numerous small slit sensilla; pleural and interscutal membranes densely papillate; anterior genital operculum of female with about 45 acuminate setae broadly scattered over surface. Spermathecae of female apparently consisting of two delicate, lateral tubes of moderate length and barely enlarged at ends. Genital features of male unknown. Cheliceral palm with five setae, all long and simple; flagellum of four setae, all finely denticulate along anterior margins; galea with five branches emerging from common base, each branch with 2 to 4 rami. Palps fairly heavy; chelal hand (female) very broad at base; fingers with accessory teeth; venom apparatus well developed only in movable finger, vestigial in fixed finger; trichobothrium *st* near middle of movable finger, closer to *t* than to *sb*; *ist* at same level as *est*, distal to middle of fixed finger, *esb*, *eb*, *isb* and *ib* closely grouped at base of finger. Legs monotarsate, moderately slender; tibia IV with tactile seta far distad (also on III); tarsus IV with tactile seta just distad of middle (also on III) and prominent slit sensillum close to base (also on I, II, III); sub-terminal tarsal setae curved, acuminate; claws simple.

¹ This work was supported in part by a grant (GB 17964) from the National Science Foundation.

TYPE SPECIES.—*Atemnus hirsutus* Banks, 1914.

DISTRIBUTION.—Known only from Laguna Beach, California.

REMARKS.—This genus is a member of the family Chernetidae by virtue of the monotarsate legs, the occurrence of a well developed venom apparatus in the movable chelal finger only, the accessory teeth on the chelal fingers, and the presence of a prominent, longitudinally oriented, slit sensillum basally on each pedal tarsus.

The relationship of *Mucrochernes* to other genera in the family is obscure because of the unique nature of the vestitural setae. Some other genera, such as *Dasychernes* Chamberlin, have large numbers of setae, but no other pseudoscorpion has been reported to have setae similar in shape to those of *Mucrochernes*. In fact, all other known chernetids have at least some setae which are denticulate or clavate at the tips, while those of *Mucrochernes* are, without exception, simple at the tips. On the basis of this and other features, the present genus does not fall naturally into any of the subfamilies of Chernetidae as presently formulated. It is possible that reevaluation of these groups on the basis of a broader constellation of characters will reveal close relatives of *Mucrochernes*.

MUCROCHERNES HIRSUTUS (Banks), new combination
(Figs. 1-6)

Atemnus hirsutus Banks, 1914, p. 203.

Genus? *hirsutus*, Hoff, 1958, p. 22.

MATERIAL.—Holotype female (WM 2456.01001), "found 10 ft. from ocean. No trees near," at Laguna Beach, Orange County, California (no date or collector indicated on slide, though Banks states that the specimen was sent by Prof. Hilton).

Because the original description given by Banks is inaccurate in some details and generally not sufficient to define the species, the following more complete description is presented.

FEMALE.—All parts rather lightly sclerotized and light yellowish. Carapace slightly longer than broad, with two transverse furrows and two large, distinct eye spots; surface nearly smooth medially, but weakly granulate on sides and posteriorly; covered with more than 200 setae. Setae on carapace, as well as on remainder of animal, different from those of other pseudoscorpions—all long, thin and completely simple at tips, but often with single, small, sharp spinule about halfway along length of shaft (Fig. 1).

Abdomen twice as long as broad; tergites and sternites, except 11th, divided, surfaces very finely granulate; pleural membranes and interscutal surfaces densely papillate. Tergal chaetotaxy 26:29:28:39:51:51:57:60:54:53:43:2; setae in single marginal row on tergites 1 to 3, but in irregular double or triple rows on tergites

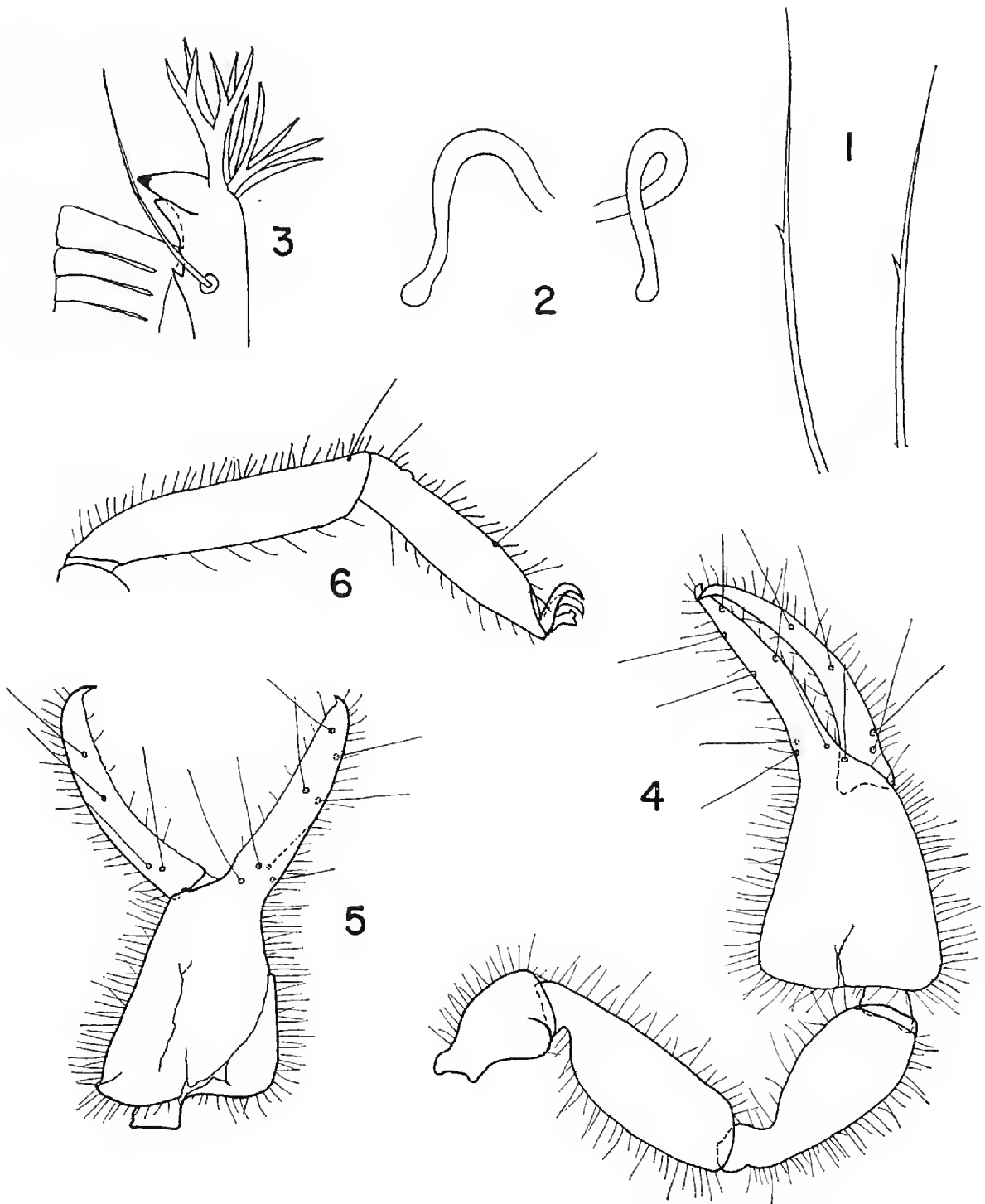


FIG. 1-6. *Mucrochernes hirsutus* (Banks), holotype female. FIG. 1. Vestitural setae with lateral spinules. FIG. 2. Spermathecae. FIG. 3. Tip of movable finger of chelicera, showing complex galea. FIG. 4. Dorsal view of right palp (chela in dorsolateral aspect and with crack in hand). FIG. 5. Lateral view of left chela (hand broken). FIG. 6. Tibia and tarsus of leg IV, showing tactile setae and tarsal sensillum.

4 to 11. Sternal chaetotaxy 43:(1)22(2):(3)14(3):64:68:50:49:48:47:36:2; the setae in double or triple rows on sternites 5 to 11. Sternites 4, 5 and 6 with numerous small, slit sensilla scattered over surfaces (each sternal half with about 40 on 4, about 85 on 5, and about 75 on 6), other sternites with few such sense organs (each half with about 12 on 3, only 2 on 7, 1 on 8, etc.). Anterior genital

operculum with a broad field of 43 small setae; posterior operculum with irregular, marginal row of 22 setae of similar size. Setae on spiracular plates simple. Spermathecae difficult to observe but appear to consist of two thinwalled lateral tubes, barely enlarged at ends (Fig. 2). Coxal area generally typical; all coxae bearing numerous, apparently simple setae.

Chelicera generally typical of the family, about one-third as long as carapace. Palm with five setae, all relatively long and simple. Fixed finger with three tiny, subterminal denticles and five teeth of decreasing size along the margin. Movable finger (Fig. 3) with distinct subapical lobe and one medium sized tooth just proximad of this. Galea composed of five branches arising from common base, each branch with two or four rami. Flagellum of four setae, all finely denticulate along anterior margins. Serrula exterior with 19 blades; serrula interior of six dentate lobes and basal velum.

Palp essentially as illustrated by Banks (1914, p. 203), though in the copy of the Journal available to me, the lateral outline of the tibia is incomplete. Remounted palp (chelal hands slightly broken by original, unsupported cover glass) as in Fig. 4. Surfaces smooth, except for a few small granules on flexor surfaces of trochanter, femur, and tibia; covered with numerous setae, mostly simple but some with spinules on shafts. Trichobothria of chela as in Fig. 5. Chelal fingers slightly gaping; fixed finger with 63 low, strongly cusped, marginal teeth, and five internal and eight external accessory teeth; movable finger with 59 similar marginal teeth, and five internal and seven external accessory teeth. Venom apparatus well developed in movable finger, with nodus ramosus just proximad of trichobothrium *t*; fixed finger without specialized venedens, but with small, poorly preserved venom duct. Trochanter 1.7, femur 3.1, tibia 2.65, and chela about 5.2 times as long as broad; hand 1.25 times as long as deep; movable finger 1.17 times as long as hand.

Legs typical in form, rather slender; leg IV with entire femur 4.25, tibia 5.1 and tarsus 4.35 times as long as deep. Tactile setae on tibia 0.93 and on tarsus 0.62 the length of segment from proximal end (Fig. 6). Large, prominent slit sensillum at proximal fifth of outer margin of segment. Subterminal tarsal setae curved, simple.

MALE.—Unknown.

MEASUREMENTS (mm).—Body length 3.06. Carapace 0.99 long, posterior breadth 0.89. Chelicera 0.36 long by 0.185 broad; movable finger 0.295 long. Palpal trochanter 0.54 by 0.32; femur 0.985 by 0.32; tibia 0.925 by 0.35; chela (without pedicel) 1.725 by 0.33; hand (without pedicel) 0.79 by 0.63; movable finger 0.925 long. Leg I: basifemur 0.25 by 0.17; telofemur 0.48 by 0.15; tibia 0.41 by 0.12; tarsus 0.43 by 0.095. Leg IV: entire femur 0.85 long; basifemur 0.30 by 0.20; telofemur 0.63 by 0.20; tibia 0.665 by 0.13; tarsus 0.52 by 0.12.

REMARKS.—There are two inaccuracies in Banks' description of the species which deserve some comment.

1) As mentioned above, and as observed by Banks, all setae on the animal are simple at the tips. However, probably because of insufficient magnification, Banks failed to notice the small spinules on the shafts of many of the setae. It is impossible to determine how many setae actually possess this feature because the spinule is usually obscured

by the shaft of the seta unless the seta is positioned so that the spinule extends out to one side.

2) It is difficult to understand why Banks recorded "mandible . . . with a short stylet," when the cheliceral galea is, in fact, large and multiply branched. It is conceivable, however, that one of the chelicerae, which seems to have been treated differently from the other, might have appeared to have a simple galea when viewed in a certain position under low magnification.

It is of special interest to note the occurrence of a large, prominent, slit sensillum basally on the outer surface of each pedal tarsus. The slit is oriented along the long axis of the segment and opens across the surface of a rounded elevation. In lateral view, as the legs are usually oriented, the organ is seen as a distinct, curved bump on the tarsal surface. This structure apparently was first noted by Chamberlin (1924), who called it a "dome-like 'sense-spot'"; later (1938, etc.) he referred to it as a "sense dome." Oddly, it is not mentioned at all in Chamberlin's large monograph "The arachnid order Chelonethida" (1931). Vachon (1945) observed that he had found this "organe tarsal" in representatives of all three subfamilies of the Chernetidae but in no other family, and he suggested that it is a good diagnostic character of the family Chernetidae. Unaccountably, then, Vachon did not include this character in his revised diagnosis of the Chernetidae (1951, p. 171), though he did mention it again two paragraphs beyond. My own experience agrees with that of Vachon and I concur that these slit sensilla are unique to the Chernetidae, the diagnostic features of which can be listed as follows: all legs monotarsate; venom apparatus well developed in movable finger of chela, less well developed or absent in fixed finger; fingers of chela usually with accessory teeth external and internal to the marginal row; tarsus of each leg with a prominent slit sensillum on the outer surface proximal of the middle of the segment.

It is to be hoped that the foregoing will stimulate enough interest in this remarkable pseudoscorpion to result in the collection of additional specimens of the same or related species.

LITERATURE CITED

- BANKS, N. 1914. A new pseudoscorpion from California. *J. Entomol. Zool., Pomona Coll.*, 6: 203.
- BEIER, M. 1932. Pseudoscorpionidea. II. Subord. Cheliferinea. *Teirreich*, 58: 1-294.
- CHAMBERLIN, J. C. 1924. *Hesperochnes laurae*, a new species of false scorpion from California inhabiting the nest of *Vespa*. *Pan-Pac. Entomol.* 1: 89-92.

1931. The arachnid order Chelonethida. Stanford Univ. Publ. Biol. Sci. 7, no. 1: 1-284.
1938. New and little-known false scorpions from the Pacific and elsewhere. Ann. Mag. Nat. Hist., ser. 11, 2: 259-285.
- HOFF, C. C. 1958. List of the pseudoscorpions of North America north of Mexico. Amer. Mus. Novitates, 1875: 1-50.
- ROEWER, C. FR. 1937. Chelonethi order Pseudoskorpione. In Bronns, H. G., Klassen und Ordnungen des Tierreichs, Leipzig, vol. 5, div. 4, book 6, fasc. 2, pp. 161-320.
- VACHON, M. 1945. Chernetes. Mém. Mus. Nat. Hist. Natur. Paris, Ser. A, Zool., 19: 187-197.
1951. Les Pseudoscorpions de Madagascar. I. Remarques sur la famille des Chernetidae J. C. Chamberlin, 1931, à propos de la description d'une nouvelle espèce: *Metagoniochernes Milloti*. Mem. Inst. Rech. Sci. Madagascar, ser. A, Biol. Anim., 5: 159-172.
-

COLLECTION DONATED

Chris Parrish Scorpion Collection Donated to California Academy of Sciences.—Mr. Chris Parrish of La Mesa, California, has recently donated his collection of scorpions and other arthropods to the Department of Entomology, California Academy of Sciences. This collection, consisting of 3,784 specimens (plus a collection of diplocentrid scorpions out on loan for study) is important and valuable since it contains series of scorpions both from the mainland of Baja California, Mexico and the islands of the Gulf of California. The majority of the Mexican collections were made on expeditions organized by Dr. George E. Lindsay, Director of the California Academy of Sciences.

The Parrish collection contains 2,241 scorpions (plus the diplocentrid scorpions) including seven holotypes and two allotypes described by Dr. Herbert L. Stahnke (holotype female, *Bioculus aguajensis*; holotype female, allotype male, *B. belvederi*; holotype female, *B. danzantiensis*; holotype female, *B. lindsayi*; holotype female, *B. luteus*; holotype female, *B. parraensis*; holotype male, allotype female, *B. parrishi*), 1,399 specimens from Mexico, and 833 from the western United States. Most of these specimens were collected by non-ultra-violet detection methods. They will complement the extensive series of scorpions which Dr. Stanley C. Williams, who is monographing the scorpions of Baja California, has collected and donated to the Academy. The collection also contains 36 Uropygi and Amblypygi, 42 Solpugida, 61 Chilopoda, 50 Diplopoda, 128 Opiliones, 74 Chelonethida, 599 Araneida, 1 Onychophora, 276 Acarina, and 266 Insecta.—PAUL H. ARNAUD, JR., California Academy of Sciences, San Francisco, 94118.

A New *Pulverro* from California

(Hymenoptera: Sphecidae)

LLOYD E. EIGHME

Pacific Union College, Angwin, California 94508

A study of the genus *Pulverro* has disclosed some interesting new material especially from the North Coast Ranges of California. A new species, *Pulverro monticola* Eighme was described from specimens collected in the Salmon-Trinity Mts. in 1968. Subsequent collecting trips in the same area have resulted in specimens of another new species described in this paper.

Specimens of the new species were first collected by the author in August 1969 in the Deer Creek Basin at 5,300 feet elevation in the Salmon-Trinity Mts. of Trinity County, California. The following summer, June 1970, one of my students, Terry Griswold, collected specimens of the same species near Healdsburg, Sonoma County, and in July 1971, another student, Earl Aagaard, collected more specimens of the same species in Young's Valley at 4,600 feet elevation in Siskiyou County. Dr. R. M. Bohart (Dept. of Entomology, Univ. of Calif., Davis) discovered eight specimens in the U. C. Davis collection from Shasta County and recognized them as a new species, but graciously loaned them to me as a part of the series to be described in this paper.

The holotype of this new species will be deposited in the collection at the California Academy of Sciences. Paratypes will be placed in collections at the University of California at Davis, the U.S. National Museum, and the Philadelphia Academy of Sciences.

***Pulverro californica* Eighme, new species**

MALE.—Length 3 mm. Color, black; foretibia and tarsi, apex of fore femur, mid and hind tarsi and base of mid and hind tibiae golden brown; labrum, palpi and mandibles ivory except apices and tip of ventral tooth of mandibles red; apices of antennal segments brown underneath. Wings clear hyaline, stigma and veins dark brown.

Head subquadrate when viewed from above, narrower in occipital width than ocular width. Mandibles bidentate with distinctly pointed midventral tooth placed at right angle to ventral margin. Clypeus with distinctly raised medial subquadrate platform as broad as the distance between the antennal sockets. Ventral margin of clypeus with sharply angled median truncate lobe. Clypeus and front adjacent to antennal sockets densely clothed with flattened silvery pubescence. Remainder of front and vertex finely granular with few scattered fine hairs. Supraorbital fovea a minute round puncture at apical margin of eye. Antenna filiform with first segment of flagellum greater in diameter than second segment.

Thorax shining, finely punctate. Scutum projected forward above pronotum, smoothly rounded anteriorly and laterally with notauli prominent anteriorly for almost half length of scutum. Lateral furrow between scutum and scutellum deep and lightly foveolate. Propodeum granulate on sides, dorsal face coarsely reticulate, posterior face flattened with median furrow and dorsolateral margins outlined by sharp carina.

Abdomen shining, minutely rugulose. Tergites 2-5 with prominent transverse groove at middle, appearing as secondary division of somite. Posterior border of tergites 2-5 depressed and marked by narrow row of irregular punctures.

Last tergite coarsely punctured and armed with short stiff bristles. Second sternite with transverse arcuate groove anteriorly, third sternite with straight transverse groove. Hypopygium (last sternite) spatulate, apical margin rounded, sharply serrate with tuft of fine pubescence underneath, silvery hairs less than one-half as long as hypopygium.

FEMALE.—Similar to male except: Central clypeal disc roundly tumid, extending upward between antennal sockets and projecting anteriorly into broad subtruncate flange. Clypeal disc smooth, shining, with large scattered punctures. Labrum not extending beyond clypeal flange. Mandibles bidentate but lack midventral tooth. Supraorbital fovea linear, as long as diameter of lateral ocellus. Frons with faint median carina terminating in shallow pit about $\frac{2}{3}$ distance from clypeus to median ocellus. Pygidial plate trigonal, margined by sharp carina, apex narrowly truncate, shining, with few large punctures.

Holotype male, (CAS), DEER CREEK, 5,300 FEET, TRINITY COUNTY, CALIFORNIA, 7 August 1969 (L. Eighme). Paratypes, 7 males, 5 females from same locality as holotype. Additional specimens: 16 males and 4 females from Siskiyou County, 5,000 feet, California; 3 males and 5 females from Shasta County, California; 4 males and 1 female from Healdsburg, Sonoma County, California.

This species is similar to *P. chumashano* Pate which is found in coastal southern California, but strikingly different from *P. monticola* Eighme which is found in some of the same areas as the new species. *Pulverro californica* differs from *P. chumashano* in the males in that the midventral mandibular tooth is smaller and more pointed, the last sternite is evenly rounded instead of broadly truncate, and sparsely hirsute instead of densely hirsute, the integument is generally black instead of dark mahogany. The females of *P. californica* differ from those of *P. chumashano* in that the labrum does not extend beyond the clypeal flange in *P. californica* whereas it does in *P. chumashano*.

LITERATURE CITED

- EIGHME, L. E. 1968. A New Species of *Pulverro* from California. Pan-Pac. Entomol., 44(4): 261-264.

**Description of a New Species of *Trjapitzinellus* Parasitic on
Coniopterygidae in California^{1, 2}.**

(Hymenoptera: Encyrtidae; Neuroptera)

GORDON GORDH

Department of Entomology, University of California, Riverside, 92507

Slides in the collection of the Citrus Experiment Station, University of California, Riverside, indicate the presence of a new species of encyrtid from California as suspected by P. H. Timberlake in 1928. Subsequent collections by Paul DeBach and Harold Compere in southern California during the 1930's and 1940's revealed more individuals similar to Timberlake's material. Intensive collecting by J. A. McMurtry during the 1960's associated the parasite with species of *Conwentzia* and *Parasemidalis* (Coniopterygidae). Owing to the taxonomic status of the Bothriothoricini (= Mirini Ashmead), no attempt was made by Timberlake, Compere, or DeBach to describe the species. Recently, Viggiani (1967) described a genus of encyrtid parasitizing Coniopterygidae in southern Italy which is congeneric with the material collected by DeBach, Compere, and Timberlake. Research by R. Malone on synecological aspects of *Trjapitzinellus microrphanos*, sp. nov., necessitates description of this species.

***Trjapitzinellus microrphanos* Gordh, new species**

FEMALE.—Body length 2.3 mm. Head, mesosoma, gaster blackish brown; malar space, face with mauvish refringence; antennal scape reddish brown, remaining segments lighter; wings hyaline, without infuscation; coxae, femora, basal half of tibiae concolorous with body; trochanters, apical portion of tibiae, tarsi tan.

Head hypognathous, in dorsal aspect more than twice as wide as median length; anterior margin transverse; posterior margin concave between compound eye; frontovertex (at narrowest) about $\frac{1}{4}$ head width; ocelli forming acute triangle, lateral ocelli touching inner margin of compound eyes; median ocellus in center of frontovertex lateral ocelli less than diameter of one ocellus from posterior margin. Frontal aspect of head (Figs. 4, 5) triangular, compound eye height slightly greater than malar space; toruli at ventrolateral margin of clypeus, separated by 4 times diameter of single torulus; scrobe indistinct, interantennal ridge not conspicuous; inner margin of compound eye with conspicuous line of setae extending along inner margin of subocular suture, ending beneath torulus. Antenna 11-segmented (Fig. 2); scape with ventral flange; pedicel twice longer than first

¹ I am grateful to D. P. Annecke, Plant Protection Institute, Pretoria, Republic of South Africa, for comparing the material with his collection of African Encyrtidae and V. Trjapitzin, Soviet Academy of Science, Leningrad, for comparison with the Palearctic material at his disposal; Harold Compere kindly provided access to his extensive collection of Encyrtidae. Professor C. D. Michener, University of Kansas, Lawrence, reviewed the manuscript and suggested improvements.

² Support of NSF GB-17829 to Paul DeBach is gratefully acknowledged.

flagellomere; flagellomeres uniformly setose with few carinae, becoming progressively larger distally; club compact, setose, with curved sensory margin dorsad. Head lightly shagreened, compound eye with uniform covering of short setae; mandibles tridentate; maxillary palp 4-segmented (Fig. 7), labial palp 3-segmented (Fig. 6).

Mesosoma (Fig. 8) twice as long as wide; dorsal surface flattened. Mesoscutum, scutellum, axilla lightly shagreened; tegula strongly shagreened, setose; propodeum with few coarse striations; mesoscutum with uniform vestiture of pale thin setae; scutellum with longer, more irregularly dispersed setae; axilla, metanotum, propodeum aetose. Legs not modified; middle tibial spur (Fig. 3) $\frac{2}{3}$ length of basitarsus and subequal length. Forewing (Fig. 9) about $2\frac{1}{3}$ times longer than greatest width, lacking infuscation; submarginal, marginal vein limits not evident, forming single straight vein, with marginal vein distinct distally; costal cell well-developed, setose; postmarginal vein at least as long as stigmal vein, terminus indistinct; speculum present, but lateral margins not straight or distinct; hindwing (Fig. 10) with submarginal, marginal veins subequal, submarginal vein arched forward; entire wing surface distal to imaginary line perpendicular to union of marginal and submarginal veins covered with setae of uniform length.

Gaster shorter than mesosoma, rounded at apex, ovipositor and gonostylus not visible from above; ovipositor and hind tibia subequal in length.

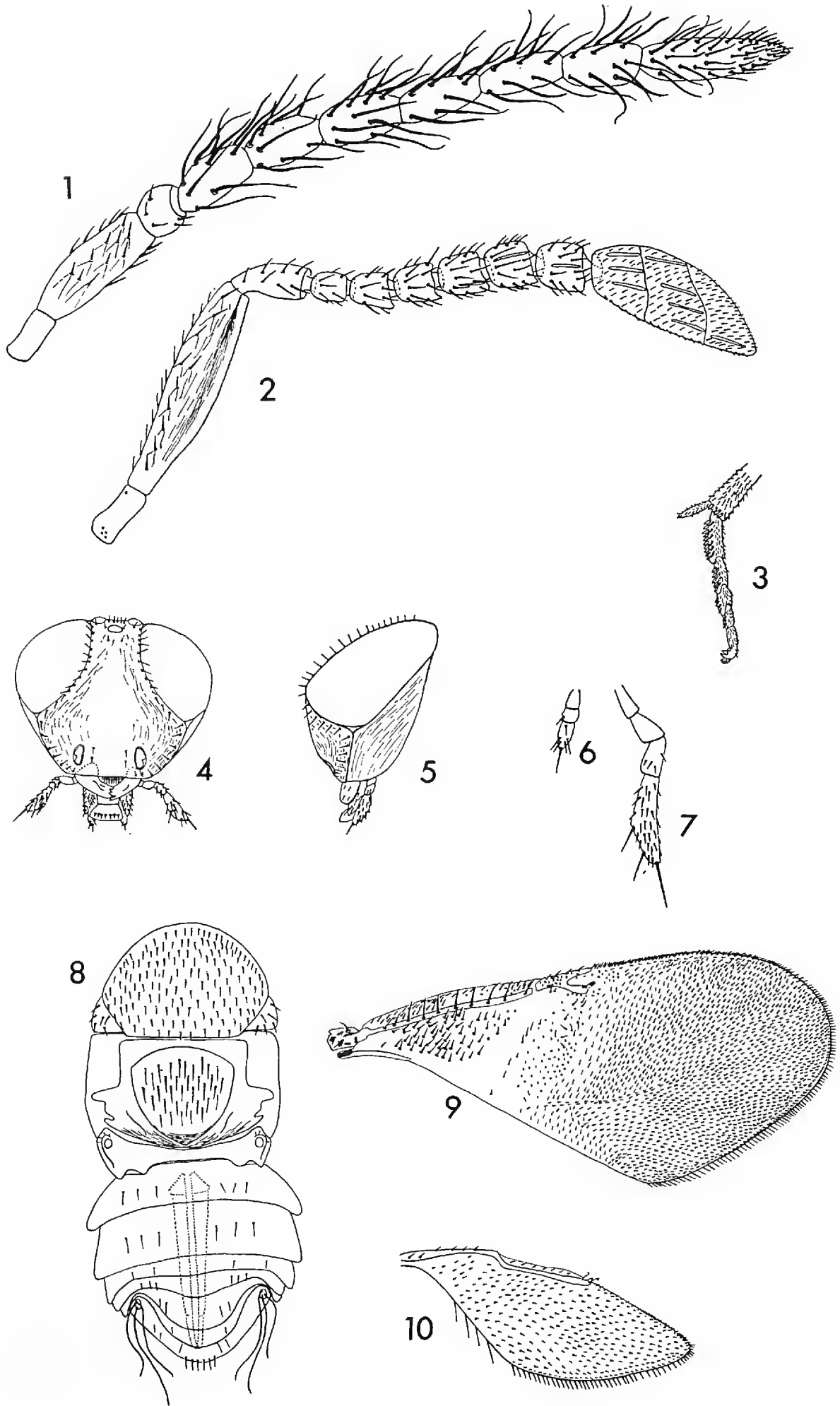
MALE.—Body length 2.0 mm. Color as female except antenna light brown with reddish refringence. Head shape as female; ventral margin of antennal torulus above clypeal margin by height of one torulus. Antenna (Fig. 1) 9-segmented; six flagellomeres subequal in size, twice as long as wide. Aedeagus exerted subequal in length to hindbasitarsus and second tarsomere.

BIOLOGICAL ASSOCIATIONS.—Fleschner and Ricker (1953) indicate four genera of coniopterygids are found in southern California, *Parasemidalis*, *Conwentzia*, *Coniopteryx*, and *Malacomyza*. *Parasemidalis flaviceps* Banks and *Conwentzia nigrans* Carpenter are most abundant in citrus groves. Preliminary studies by McMurtry indicate *T. microrphanos* parasitizes *Conwentzia* sp. and *Parasemidalis* sp. during the larval stage before the cocoon is spun. The parasite pupates within the prepupal skin of its host.

COMPARATIVE COMMENTS.—In his generic description, Viggiani (1967) relied upon the observations of Trjapitzin in establishing affinities between *Trjapitzinellus* and related bothriothoracines. Trjapitzin supposed the genus to be related to *Aphidencyrtus* Ashmead, *Aphiden-*

→

FIG. 1. Inner aspect left antenna ♂ *T. microrphanos* ($\times 45$). FIG. 2. Inner aspect left antenna ♀ *T. microrphanos* ($\times 45$). FIGS. 3–10. ♀ *T. microrphanos* ($\times 40$): FIG. 3. Right tibiotarsus, FIG. 4. Head anterior aspect, FIG. 5. Head lateral aspect, FIG. 6. Left labial palpus, FIG. 7. Left maxillary palpus, FIG. 8. Dorsal view of meso- and metasoma, FIG. 9. Right forewing, and FIG. 10. Right hindwing.



cyrtoides Ishii, *Baeonusia* Girault, *Geniaspidius* Masi, *Mercetencyrtus* Trjapitzin and *Ooencyrtus* Ashmead. Viggiani added that on the basis of body shape *Trjapitzinellus* is intermediate between *Ooencyrtus* and *Psyllaephagus*. Comparison of *T. microrphanos* with Compere's collection of encyrtids confirms Viggiani's suspicions. However, the systematic position of *Trjapitzinellus* is still unsatisfactory and revision of the Bothriothoracini seems essential before relationships are established. Perhaps the most distinctive feature of *T. semidaliphagus* Viggiani and *T. microrphanos* is the dorsal curved sensory margin of the female's antennal club.

Biologically, *T. semidaliphagus* has been recovered from *Semidalis aleurodiformis* Steph. in southern Italy only.

Both sexes of *T. microrphanos* may be distinguished from *T. semidaliphagus* on the basis of the following characters: (1) the distal end of the marginal vein of the forewing is broken in *T. microrphanos*, but continuous in *T. semidaliphagus*; (2) the forewing of *T. microrphanos* bears setal tracts absent from *T. semidaliphagus*; and (3) *T. semidaliphagus* lacks the conspicuous line of setae extending along the inner margin of the compound eye and subocular suture. The second segment of the female maxillary palpus of *T. microrphanos* is glabrous while the corresponding segment of *T. semidaliphagus* bears setae.

MATERIAL EXAMINED.—CALIFORNIA: San Diego Co., 13 ♀, 8 ♂, Pauma Valley, 26 March 1963, leg. J. A. McMurtry ex. coniopterygid from citrus; 11 ♀, 3 ♂, El Toro, 20 July 1964, J. A. McMurtry from coniopterygid on citrus. Orange Co.: 17 ♀, 7 ♂, Santa Ana Canyon, 9 July 1963, from coniopterygid on citrus, J. A. McMurtry. Santa Barbara Co.: 1 ♀, 2 ♂, 6 February 1964, Carpinteria, from coniopterygid on Avocado, L. Bailard; 5 ♀, 3 ♂, Santa Barbara, 25 July 1964, from coniopterygid on citrus, J. A. McMurtry. Ventura Co.: 5 ♀, 3 ♂, Ladera Ranch, Fillmore, 16 May 1963 and 2 August 1963, from coniopterygid on citrus, J. A. McMurtry. San Bernardino Co.: 4 ♀, 2 ♂, Redlands, 24 July 1963, from coniopterygid on citrus, J. A. McMurtry. Riverside Co.: 4 ♀, 1 ♂, Riverside, 10 May 1963, from coniopterygid on citrus, J. A. McMurtry.

Holotype female and allotype, LADERA RANCH, FILLMORE, VENTURA COUNTY, CALIFORNIA 2 August 1963, Coniopterygidae on citrus, J. A. McMurtry, Collector, both card-point mounted.

PARATYPES.—3 ♀ and 3 ♂, Santa Ana Canyon; 1 ♀, Riverside; 7 ♀ and 4 ♂, Pauma Valley; 1 ♀, Redlands; 1 ♀, Santa Barbara; 1 ♂, Fillmore; all card-point mounted.

DISPOSITION OF TYPES.—(Names in parentheses indicate individual to whom material was sent.) Holotype, Allotype, 1 ♀ and 1 ♂ Paratypes, Snow Entomological Museum, University of Kansas, Lawrence, Kansas (G. W. Byers). Paratypes have been assigned to the following institutions: 2 ♀ and 1 ♂, U.S.

National Natural History Museum (B. D. Burks); 1 ♀ and 1 ♂, Plant Protection Research Institute, Pretoria, Republic of South Africa (D. P. Annecke); 1 ♀ and 1 ♂, British Museum (Natural History), London, England (G. A. Kerrich); 1 ♀ and 1 ♂, Zoological Institute, Soviet Academy of Sciences, Leningrad, USSR (V. A. Trjapitzin); 1 ♀ and 1 ♂, Department of Entomology, University of California, Riverside, California.

LITERATURE CITED

- FLESCHNER, C. A. AND D. W. RICKER. 1953. Food habits of coniopterygids on citrus in southern California. *Econ. Entomol.*, 46: 458-461.
- VIGGIANI, G. 1967. Ricerche sugli Hymenoptera Chalcidoidea XIII. Sugli entomoparassiti della *Semidalis aleurodifformis* Steph. (Neur. Coniopterygidae), con descrizione di un nuovo genere di Encyrtidae. *Boll. Lab. Ent. Agr. Portici*, 25: 164-175.

BOOK REVIEW

PRINCIPLES OF INSECT CHEMOSTERILIZATION. Edited by Germain C. La Brecque and Carrol N. Smith. Appleton-Century-Crofts, New York. 354 p., 13 figs., 32 tables. 1968. \$16.00.

This is the first comprehensive survey of chemosterilization for population control in insects. Nine contributors, eight from the U. S. Department of Agriculture and one from the U. S. Public Health Service cooperated in producing the seven chapters.

In Chapter 1, A. W. Lindquist introduces the topic by evaluating insects as pests, reviewing the current methods of control, and introducing the sterile-male concept. Chapter 2 by E. F. Knipling presents the theoretical background for sterilizing and releasing laboratory reared insects among natural populations and for direct field sterilization of portions of natural populations. Germain C. La Brecque discusses in Chapter 3 the laboratory procedures for screening chemosterilants, testing their quantitative effects by different methods of application, and determining field potential from detailed studies of the effects of a sterilant in or on an insect. In Chapter 4, Leo E. La Chance, David T. North and Waldemar Klassen discuss the basis of chemosterility at the cellular and cytogenetic levels. Ralph B. Turner presents a summary of the physical and chemical properties of some representative groups of chemosterilants and their biochemistry in Chapter 5. Field studies and evaluations of chemosterilants on specific insects (e.g., House fly, Screwworm, Cabbage looper, Boll weevil, Mosquitoes) and the use of chemosterilants as a tool in basic biological studies of insect reproductive behavior and population structure and dynamics are presented in Chapter 6 by D. E. Weidhaas. In Chapter 7 Wayland J. Hayes, Jr. reviews information on aspects of mammalian toxicity of chemosterilants for use in insect population control.

Each chapter is followed by its own set of references and a terminal index to the volume is provided. This book is an invaluable review which deserves a place on the bookshelves of all those interested in possible alternatives to pesticides as methods of controlling insect populations.—ROBBIN W. THORP, *University of California, Davis, 95616.*

Larval Description and Notes on the Biology of
Anthocomus horni
(Coleoptera: Melyridae)

DAVID E. FOSTER AND ARTHUR L. ANTONELLI

Department of Entomology, University of Idaho, Moscow 83843

The taxonomy of the North American representatives of *Anthocomus* has been covered by Marshall (1949). Their larvae have not been described and only one species, *Anthocomus auritus* (LeConte), has been figured (Böving and Craighead, 1930). Information concerning *Anthocomus* biology has not been published. For these reasons this information, although incomplete, is being presented. Terminology used here is adapted from Böving and Craighead (1930).

BIOLOGICAL NOTES.—On 18 April 1971, 29 May 1971 and 15 September 1972 nests of the black-billed magpie, *Pica pica* (Linn.), were collected on Coyote Grade, Nez Perce County, Idaho. Among insects found to inhabit the nests were larvae of *Anthocomus horni* (Fall).

The larvae of *A. horni* are not restricted to magpie nests. The species has been reared from tephritid galls growing on *Artemisia tridentata* Nuttall (Jordan Valley, Oregon, 2 May 1960, B. A. Foote) and from wood of *Pinus flexilis* James (Craters of the Moon National Monument, Idaho, 22 June 1965, D. S. Horning).

In northern Idaho *A. horni* spends the winter as a mature larva, pupating the following spring. Adults can be found from early May through mid July. They have been collected from the following plants: *Eriodictyon* sp., *Ceanothus* sp., *A. tridentata*, *Urtica Lyalli* Watson. *Anthocomus horni* has also been taken sweeping grass.

MATURE LARVA.—Length 8.1 mm, maximum width 1.6 mm, head capsule width 0.9 mm.

Body elongate, slightly tapered anteriorly and posteriorly; membranous areas mottled reddish to brown, sclerites testaceous to dark brown, surface clothed with short to long, erect or suberect, fulvous hairs.

Head with dorsal surface broadly flattened, slightly broader than long in dorsal view (6:5). Epicranium uniformly sclerotized; surface smooth to finely roughened, clothed with short to long hairs, reddish brown except for very dark brown pigmentation in ocular area; epicranial suture much shorter than cranial width in dorsal view (3:10); stemmata separate and entire, four on each side arranged in anterior row of three and single posterior one; anterior row lying in dorsoventral arc that projects slightly anteriorly, bottom stemma of arc largest with diameter of each successive stemma diminished slightly; posterior stemma slightly larger than anteroventral one. Frons subtriangular, nearly twice as broad as long; surface

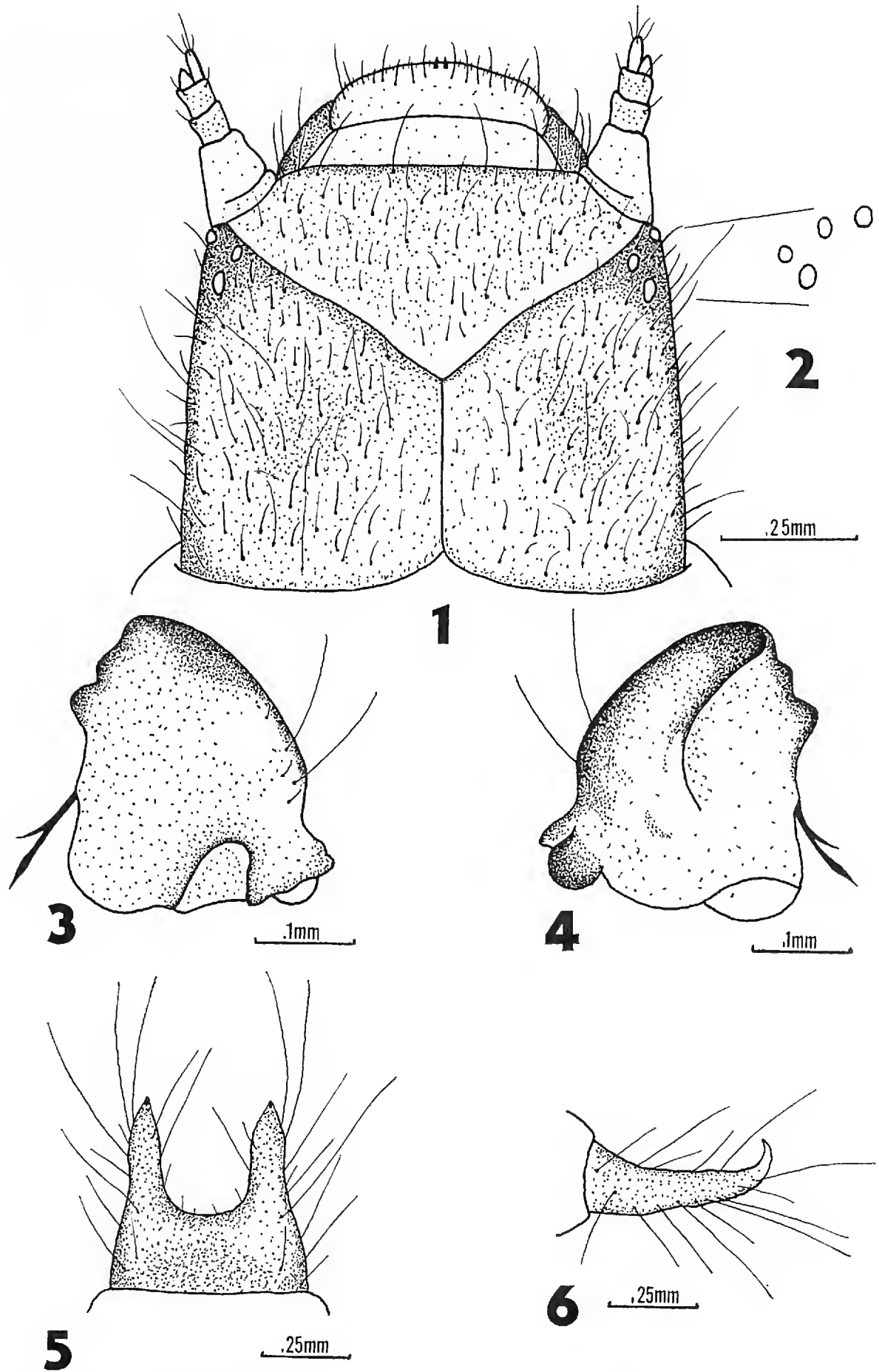


FIG. 1-6. *Anthocomus horni*, mature larva. FIG. 1. Head capsule dorsal view; FIG. 2. Stemmata lateral view; FIG. 3. Right mandible dorsal view; FIG. 4. Right mandible ventral view; FIG. 5. Urogomphi dorsal view; FIG. 6. Urogomphi lateral view.

uniformly sclerotized, irregularly sculptured and finely roughened; front margin truncate. Clypeus transverse, very lightly sclerotized, appearing almost membranous; surface very finely roughened; front margin feebly arcuate or truncate. Labrum transverse and tumescent, lightly sclerotized; surface very finely roughened, clothed with numerous short and long hairs irregularly positioned behind the feebly arcuate front margin. Antenna three segmented; basal membrane subequal to combined length of three distal segments, glabrous, cream colored, appearing inflated; basal segment slightly broader than long in dorsal view (4:3), slightly compressed laterally, circumscribed by broad reddish brown band over most of surface; middle segment slightly longer than basal segment in dorsal view (6:5), constricted at base and expanded gradually distally, slightly compressed laterally, circumscribed by a broad reddish brown band that covers most of its surface, bearing three long, stiff, cream colored hairs arising near apical margin, one hair arising laterally on each side and one middorsally, apex of middle segment bearing conical, glabrous appendix lateroventral to base of first segment, appendix shorter than apical antennal segment (2:3); apical segment subequal in length to second segment in dorsal view, digitiform, much longer than broad (4:1), color uniformly reddish brown except cream colored apex which bears four stiff hairs, three equal in length and equidistantly positioned around apical margin, fourth longer, arising from center of apex. Mandibles longer than broad in dorsal view (5:4); outer margin arcuate; inner margin tridentate, retinaculum pronounced and obliquely rounded, middle tooth small and broadly flattened, mandibular apex arcuately rounded; surface reddish brown at apex and along lateral margins, dorsal disc light brown, bearing two long and three short, stiff hairs arranged in two longitudinal rows; lacinia mobilis bifurcate, arising from inner margin half way between retinaculum and posterior angle. Maxillae and labium forming a prominent, ventrally protruding plate; maxilla with stipes lightly sclerotized, clothed with several short and long, erect hairs, palpifer membranous, bearing a single long, erect hair near inner margin, palpus with basal segment short and glabrous, middle segment about twice as long as basal segment, dorsolateral surface clothed with several short and long, stiff hairs, terminal segment about as long as middle segment, conical, apex with cluster of short, very stout hairs at apex; labrum with submentum and mentum membranous, clothed with scattered short and long, erect hairs, stipes labii with sclerotized base, bearing pair of long, erect hairs at front margin, palpus two segmented, basal segment subcylindrical, bearing several short, erect hairs around apex, terminal segment conical, about equal in length to basal segment, bearing a cluster of very short, stiff hairs at apex. Gula tumescent and glabrous, sides straight, converging slightly towards anterior end, posterior width subequal to length.

Thorax well developed, more than one-half as long as abdomen in dorsal view; prothorax subrectangular, tergum bearing long, straight and short, feebly arcuate sclerite on either side of ecdysial suture; mesothorax subtriangular, slightly wider than prothorax, tergum bearing a short, feebly arcuate sclerite on either side. Metathorax similar to but slightly broader than mesothorax.

Legs about equal in size and shape; pretarsus appendiculate, apex acuminate, basal tooth short with apex oblique.

Abdomen broadest at fifth segment; segments one through eight similar; segment nine with hind margin truncate, posterior surface covered by basal plate; urogomphi arising separately from basal plate, heavily sclerotized, nearly twice as long as

epicranial suture, distance between tips less than total length including basal plate (5:7), each urogomphus acuminate and recurved, surface reddish brown, bearing several erect hairs around middle.

MATERIAL EXAMINED.—Seven specimens from Coyote Grade, 9 miles E Lewiston, Nez Perce County, Idaho.

LITERATURE CITED

- BÖVING, A. G. AND F. C. CRAIGHEAD. 1930. An illustrated synopsis of the principal larval forms of the order Coleoptera. *Entomol. Amer.*, 11: 268–269.
- MARSHALL, M. Y. 1949. Studies in the Malachiidae II. *Entomol. Amer.*, 28: 126–132.

SCIENTIFIC NOTE

Ectoparasites and Nidicolous Acari of the Pocket Gopher, *Thomomys bottae* (Rodentia: Geomyidae).—Ectoparasites and nidicolous Acari were collected from 393 *Thomomys bottae* (Eydoux and Gervais) and seven gopher nests. All gophers were live-trapped from agricultural lands around Davis, California from April 1970 through November 1971 with 378 gophers taken from irrigated alfalfa fields, and the remainder from barley fields. The seven nests were taken from alfalfa fields. Table 1 presents the numerical relationships of ectoparasites removed from both gophers and nests. Ectoparasites were removed by brushing and detergent bath methods, and 15% of the hosts were treated with trypsin-KOH to recover all parasites. The recovery error as determined from the trypsin-KOH samples was 2.6% for *Geomydoecus oregonus* Price and Emerson, 4.8% for

TABLE 1. Ectoparasitic arthropods collected off of 393 *Thomomys bottae* and seven gopher nests from Davis, California from April 1970 through November 1971.

Ectoparasite	Number removed		Percent infested	
	gophers	nests	gophers	nests
<i>Geomydoecus oregonus</i> (Trichodectidae)	140,803	—	98.6	—
<i>Foxella ignota</i> (Ceratothylidae)	4	—	0.5	—
<i>Geomylichus</i> sp. (Listrophoridae)	27,623	—	76.7	—
<i>Hirstionyssus femoralis</i> (Laelapidae)	10,334	368	79.9	100.0
<i>Haemolaelaps geomys</i> (Laelapidae)	444	1,425	22.3	85.7
<i>Leeuwenhoekia delosa</i> (Trombiculidae)	1	—	0.2	—

Hirstionyssus femoralis Allred and 5.0% for *Geomylichus* sp. *Haemolaelaps geomys* Strandtmann was not present in any trypsin-KOH sample.

The nidicolous Acari obtained from the seven nests were: Mesostigmata—*Macrocheles merdarius* (Berlese) *Macrocheles* sp., *Parasitus americanus* (Berlese), *Parasitus* sp., *Hypoaspis* sp., *Proctolaelaps* sp.; Prostigmata—*Biscirus sylvaticus* (Kramer); Astigmata—*Tyrophagus longior* (Gervais); Cryptostigmata—*Epilohmannia* sp., *Euphthiracarus* sp., *Zygoribatula* sp.

Howard and Childs (1959: *Hilgardia* 29(7):277-358) listed *Geomydoecus oregonus* (as *Trichodectes geomydis* (Osborn)), *Haemolaelaps geomys*, *H. femoralis* (as *Hirstionyssus geomydis* (Keegan)) and *Trombicula californica* Ewing on *T. bottae* in the southern San Joaquin Valley of California. Miller and Ward (1960: *Amer. Midl. Natur.* 64(2):382-391) listed two species of *Geomydoecus*, the flea *Foxella ignota* (Baker) and six parasitic mites and three species of *Ixodes* from *T. bottae* in Colorado. Allred and Beck (1966: *Brigham Young Univ. Sci. Bull.* 8(1):1-123) categorically listed fleas, lice, mites and ticks from *T. bottae* in Utah.

The low number of fleas and absence of ticks on *T. bottae* in the Central Valley of California indicate that they are either geographically or ecologically separated from those ectoparasites.

My appreciation goes to the following individuals for identification of specimens: R. D. Price and K. C. Emerson for *Geomydoecus*; B. McDaniel and C. Coffman for *Geomylichus*; and F. M. Summers for the nidicolous Acari.—R. W. RUST, *University of California, Davis 95616.*

SCIENTIFIC NOTE

***Uroctonoides fractus* a synonymy (Scorpionida:Chactidae).**—Chamberlin (1920. *Brooklin Mus. Sci. Bull.*, 1: 36.) described a new genus and species of scorpion from Quito, Ecuador. This species, described from a single male specimen, has not been reported since. In Chamberlin's description he remarked on the close proximity of *Uroctonoides fractus* to *Uroctonus mordax* Thorell of California and Oregon. Werner (1934. *Bronns, Klassen und Ordnungen des Tierreichs.* 5, 4, 8, 283.) and Mello-Leitao (1945. *Escorpions sul-Americanos.* *Arq. Mus. Nac. Rio de Janeiro*, 40: 128.) included this genus in the subfamily Uroctoninae of the Vejovidae.

I was fortunate to be able to study the genotype of Chamberlin's species and discovered that it was a chactid, probably of the species *Teuthraustes lojanus* (Pocock). Species placement must remain somewhat uncertain since the telson and the last three caudal segments are missing. An unauthored label, in addition to the original label, was found in the specimen vial which identified the species as *Teuthraustes atramentarius* Simon. The inferior median keels of caudal segments I-II are absent however, thus eliminating *T. atramentarius* as a species choice.

I wish to express my gratitude to Dr. Herbert W. Levi of the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, for the loan of the type specimen.—MICHAEL E. SOLEGLAD, 3927 Polack Street, San Diego, California 92110.

A New Species of the Flea Beetle Genus *Chaetocnema* Found on *Dichondra* in California

(Coleoptera: Chrysomelidae)

RICHARD J. McCREA

*Office of Agricultural Commissioner, County of Los Angeles,
500 W. Temple, Los Angeles, California 90012*

A new species of flea beetle that is doing millions of dollars damage to dichondra lawns in Los Angeles County is described and the biology recorded.

Important research on *Chaetocnema* by Duckett (1920) in Maryland began in 1911 and ended with his death in 1918. Gentner (1928) described three new species including *Chaetocnema magnipunctata*, which was found in California. Poos (1955) worked on the biology of *Chaetocnema pulicaria*, *C. denticulata*, and *C. confinis* from 1934–1936. This work was of considerable help to me in my research.

Because of the economic importance, the flea beetle will merit further observation and study.

MATERIALS AND METHODS

Study of the life cycle involved rearing these life stages by a method that most nearly simulated its usual habitat. These beetles were reared on full flats of dichondra grown from seed placed in a steam treated media. The dichondra was planted four months before the start of the test. Three to four hundred beetles were introduced into a rearing cage capable of holding a full flat of dichondra. Samples measuring about two inches wide and six inches long were cut from the flat of dichondra and put in Berlese funnels daily until the first larvae appeared. Samples were then taken every third day and the results documented.

Eggs and pupae were reared on dichondra leaves, stems, and roots in clear plastic cages kept moist with dampened blotters. A pinch of sterilized soil was added for moisture control when rearing pupae.

KEY TO THE CHAETOCNEMA OF CALIFORNIA

- | | |
|--|---|
| 1. Sides of prothorax regularly arcuate from base to apex, without oblique truncations at front angles | 2 |
| Sides of prothorax obliquely truncate at front angles, with post apical angulation | 8 |
| 2. Vertex always punctate sometimes indistinctly | 3 |
| Vertex absolutely impunctate except near eyes | 5 |

3. Rows of elytral punctures confused at bases; length 2.0 mm *irregularis* Leconte
 Rows of elytral punctures regular 4
4. Punctures of head distinct; length 2.3–2.5 mm *denticulata* (Illiger)
 Punctures of head indistinct; length 1.5 mm *opacula* Leconte
5. Basal marginal line of prothorax entire, not defined by punctures 6
 Basal marginal line of prothorax defined by row of punctures, sometimes continued to middle as a line 7
6. Prothorax alutaceous, with median smooth space posteriorly; scutellar stria usually confused; color greenish bronze; tibia in part and tarsi reddish black; length 2.0–3.5 mm *subviridus* Leconte
 Prothorax not distinctly alutaceous, without smooth space; scutellar stria regular; color golden bronze; tibia and tarsi brownish yellow; length 2.0–2.5 mm *opulenta* Horn
7. Prothorax indistinctly punctate; alutaceous, basal punctures fine and close; humeri rounded, black bronzed color, antennae reddish yellow at base, five outer segments reddish black; length 1.5 mm *ectypa* Horn
 Prothorax with large, round deep punctures, surface faintly alutaceous; humeri obtuse, elytra a little wider at base than prothorax and broadly rounded to apex; brassy bronze with slight greenish tinge; basal four segments of antennae, tibia and tarsi more or less reddish yellow; length 1.75–1.95 mm *magnipunctata* Gentner
8. Head impunctate or with one puncture over eyes, prothorax nearly impunctate; length 1.5–1.8 mm *confinis* Crotch
 Head with few distinct punctures over eyes, prothorax distinctly punctate; length 1.5–1.8 mm *repens* McCrea, n. sp.

***Chaetocnema repens* McCrea, new species**

Chaetocnema magnipunctata, Jefferson, et al., 1967:9 (*nec* Gentner).

MALE.—Length 1.5 mm, width 0.9 mm. Broadly oval, robust, reddish black and slightly bronzed. Antennae reddish yellow. Anterior and middle legs and posterior tibiae and tarsi reddish yellow, posterior femora slightly reddish black. Head finely alutaceous, distinct punctures over eyes. Prothorax anterior angles obliquely truncate, post apical angulation distinct and arcuate posterolaterally, disc distinctly alutaceous without basal marginal line, punctures of moderate size, closely but not densely placed, not deeply impressed, dorsum of prothorax distinctly punctate. Humeri rounded, umbone moderate, striae impressed on disc, more deeply at sides, punctures relatively coarse, close and deep, but not serrate, intervals slightly convex, wider than striae on disc, but not at sides, surface smooth, shining, with fine interstitial punctures. Body beneath light reddish black, shining. Prosternum punctate, side pieces smooth. Abdomen sparsely indistinctly punctate. Aedeagus with smooth slope to apex when viewed laterally.

FEMALE.—Very similar to male. Length 1.7 mm. Width 1.1 mm. Genitalia lobes have smooth slope to base when viewed dorsally.

Holotype male and allotype, WHITTIER, LOS ANGELES COUNTY, CALIFORNIA, 1 September 1970, R. J. McCrea, deposited in Entomological Collection LACM. Paratypes including ten males and ten females, ex-

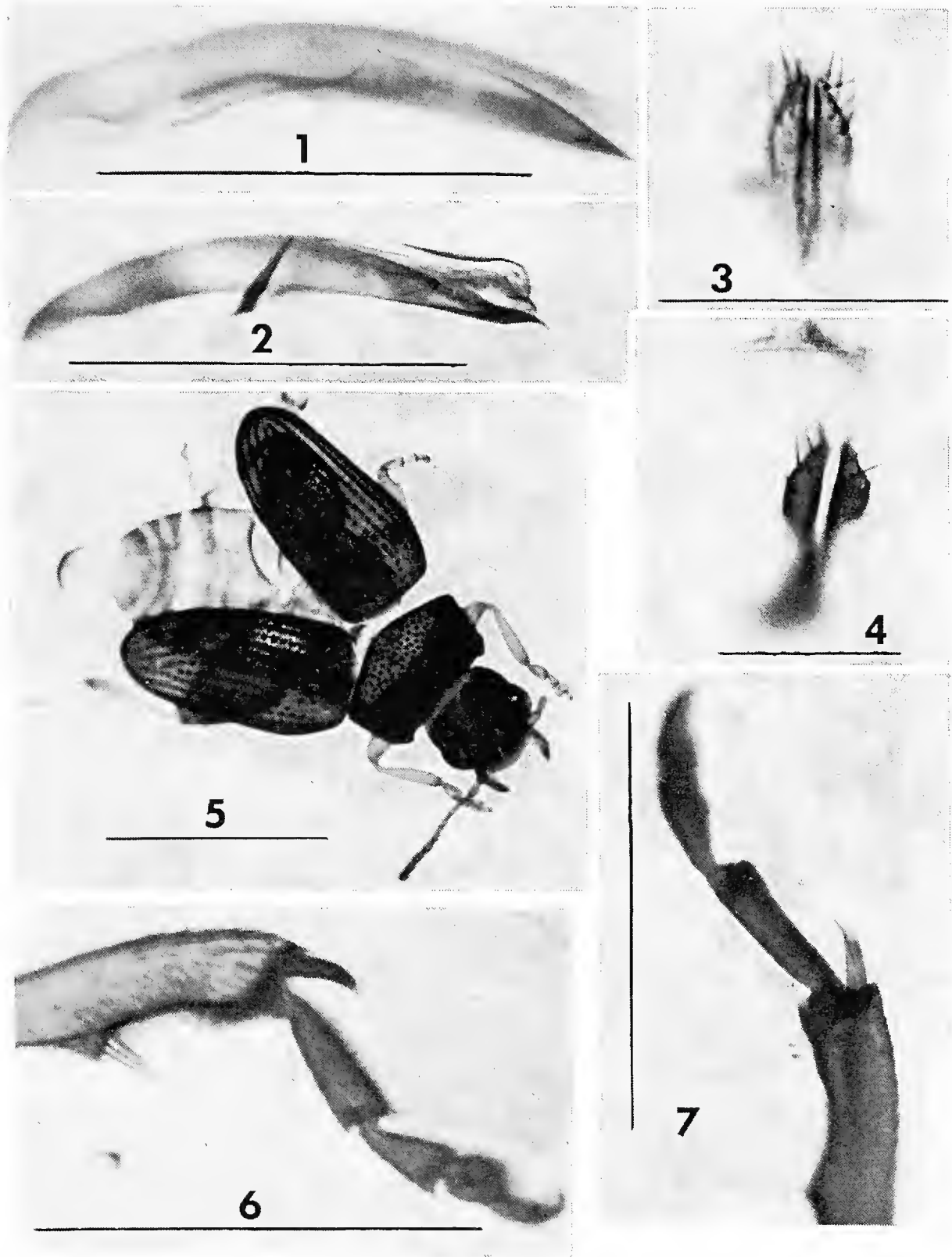


FIG. 1. Aedeagus of *Chaetocnema repens*, side view. FIG. 2. Aedeagus of *C. confinis*, side view. FIG. 3. Female genitalia of *C. repens*. FIG. 4. Female genitalia of *C. confinis* (line represents 0.25 mm). FIG. 5. Slide specimen of adult *C. repens* (line represents 1 mm). FIG. 6. End of hind tibia of *C. repens*. FIG. 7. End of hind tibia of *C. confinis*. Lines on Figs. 1-3, 6, 7 represent 0.5 mm.

amples all same data as holotype. Length 1.5–1.8 mm. Width 0.8–1.1 mm. Paratypes are placed in following collections: Los Angeles County Museum; California State University, Long Beach; Los Angeles County Agriculture Commissioner's Office, Los Angeles; and California Department of Agriculture, Sacramento.

This new species, which is very similar to *Chaetocnema confinis*, can be distinguished from it by two or three distinct punctures over the eyes and distinct punctures on the prothorax (Fig. 9) as compared to one or no punctures over the eyes and indistinct punctures on the prothorax (Fig. 10); the aedeagus having a smooth slope to the apex (Fig. 1) as compared to a depression near the apex of the aedeagus in *C. confinis* when viewed laterally (Fig. 2); dorsal view of the aedeagus also differs from *C. confinis* by not having a slight indentation near the base (Fig. 8) as compared to the indentation of *C. confinis* (Fig. 11); female genitalia differ by the genitalic lobes not having sharp angles at the base (Fig. 3) as compared to the genitalic lobes of *C. confinis* (Fig. 4); inner margin of the hind tibia is thicker in *C. repens* (Fig. 6) than the hind tibia of *C. confinis* (Fig. 7).

C. confinis and *C. repens* (Fig. 5) have the sides of the prothorax obliquely truncate at the front angles, with post apical angulations, which separates these two species from other *Chaetocnema* in California.

Chaetocnema repens occurs in Los Angeles County and in other southern counties. Recently the State Department of Agriculture submitted samples to me from Sacramento which proved to be *C. repens*. I am certain that when a complete distribution of this flea beetle is determined, the area will include much of California where dichondra is grown. Available information was taken from state and county records but *Chaetocnema* specimens were usually identified only to genus.

LIFE CYCLE

Eggs hatch three days after deposition. Eggs are deposited in dichondra sod near the surface. Eggs were deposited in clear plastic cages in the laboratory test on dichondra roots, stems, cut dichondra leaves and even on damp blotters. These eggs were measured by their width and length in microns. The range of width was 225–275 microns averaging 252 microns. The range of the length was 450–500 microns averaging 480 microns.

The larval stage takes 22 to 25 days to pupation. There are four instars as was determined by measurement of the head capsules of larvae. First instar head capsules measured 115–125 microns wide and

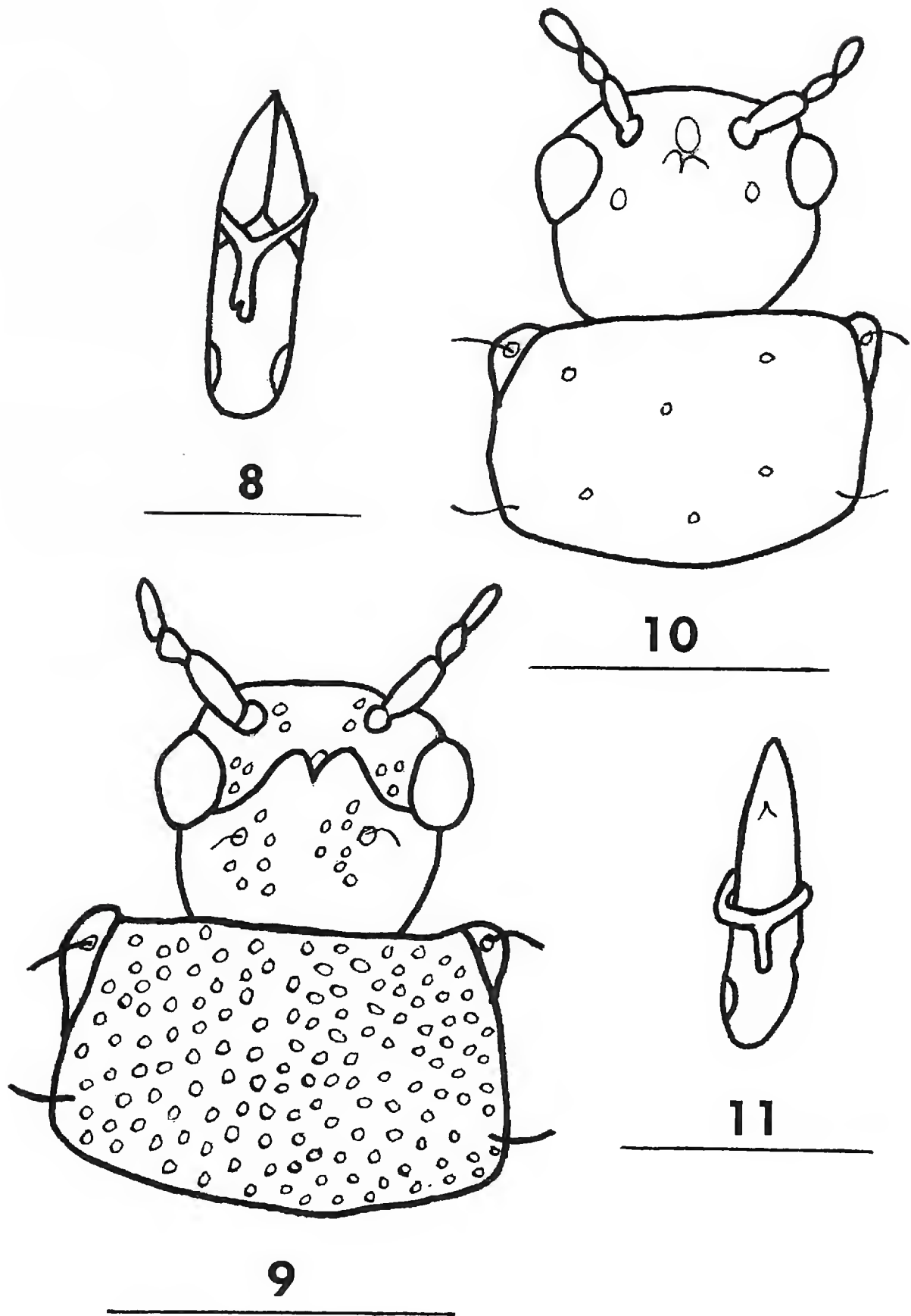


FIG. 8. Illustration of the aedeagus of *Chaetocnema repens*, dorsal view. FIG. 9. Illustration of the pronotum and part of head capsule of *C. repens*, dorsal view. FIG. 10. Illustration of the pronotum and part of head capsule of *C. confinis*, dorsal view. FIG. 11. Illustration of the aedeagus of *C. confinis*, dorsal view. Solid black line below Figs. 8-11 represents 0.5 mm.

125 microns long. Second instar head capsules were 137–150 microns in width and length. Third instar head capsules measured 187–200 microns wide and 200–212 microns long. Fourth instar head capsules measured 237–265 microns in width and length. The larval stage begins to eat dichondra roots soon after hatching. Some larvae bore into and enter small roots while others eat the outside root tissue leaving only the central vascular tissue. Larvae can be found down to five inches deep.

Pupation takes place in dichondra sod usually where the last instar larva ended up feeding on roots. Pupation takes five days to the white adult. It takes about a day for the adult to darken to its normal dark color.

The entire life cycle ranges from 32 to 35 days depending upon temperature and moisture conditions of the dichondra sod. The dichondra flea beetle overwinters as an adult in dichondra and becomes an active feeder during warm winter days in southern California.

ACKNOWLEDGMENTS

I am deeply indebted to Dr. E. L. Sleeper, Professor of Entomology at California State University, Long Beach, for the assistance and guidance he has given me throughout the entire project. I also appreciated the help that Dr. L. G. Gentner, Emeritus Professor of Entomology, South Oregon Experiment Station, gave me at the start of the research. I would like also to give credit to Ralph W. Lichty, Commissioner, and Paul B. Engler, Chief Deputy Commissioner, Los Angeles County Agriculture Commissioner's Office, for their part in permitting my staggered work schedule and their encouragement in this research.

LITERATURE CITED

- DUCKETT, A. B. 1920. Annotated list of Halticini, Univ. Md., Agr. Exp. Sta., Bull. 241: 111–155.
- GENTNER, L. G. 1928. Contributions to our knowledge of North American Halticinae. I. Notes, with descriptions of new species, Coleoptera: Chrysomelidae, Trans. Amer. Entomol. Soc., 54: 57–67.
- JEFFERSON, R. N., F. S. MORISHITA, A. S. DEAL, AND W. A. HUMPHREY. 1967. Look for turf pests now, California Turfgrass Culture, 17 (2): 9–11.
- POOS, J. 1955. Studies of certain species of *Chaetocnema*, J. Econ. Entomol., 48: 555–563.

**Possible Behavioral Thermoregulation
in *Tanarthrus salinus* and *T. inyo***

(Coleoptera: Anthicidae)

RANDALL M. PETERMAN¹

Zoology Department, University of California, Davis, 95616

This paper describes several aspects of the biology of two desert-inhabiting species of anthicid beetles, *Tanarthrus (Tanarthropsis) inyo* Wickham and the rare *Tanarthrus salinus* LeConte. In particular, evidence will be presented to suggest that these insects have special adaptations for avoiding heat stress.

These beetles, which bear a superficial resemblance to ants, are, on average, 6 mm long and 2 mm wide, and 3.2 mm by 1 mm, the larger species being *Tanarthrus salinus*. The larger species is dark red-orange on the head, thorax, elytra and legs, with the abdomen being black, including the ventral and dorsal sides of its posterior tip which protrudes beyond the elytra by 1 mm. The hind wings are semi-transparent beige. *Tanarthrus inyo* is like *T. salinus* in coloration and general characteristics except that the elytra extend to the end of the abdomen and the rear half of the elytra are black. Both species are carnivorous scavengers, feeding on windblown material such as dead insects.

METHODS

Observations were made in parts of August and September 1969 in a four square mile area in the middle of Carson Sink, near Fallon, Nevada. This area is a level, dry (but seasonally flooded) mud flat, lacking any form of plant life (except perhaps algae) and having only a small endemic animal population. There are few rocks and no standing water, and the soil surface is hard-packed. "Peeling" mud cakes in the usual sense are not found. On a macroscopic level then, the habitat appears to be relatively homogeneous. On the microhabitat level, however, the ground is more heterogeneous. Small cracks ranging from 1 to 5 mm in width are often found, and there are a few small (10 cm high) sand accumulations scattered throughout the area. The anthicids studied spend part of their time on the surface and part in these cracks, which offer them their only reprieve from direct sunlight.

Temperature data were gathered with a YSI telethermometer (50°

¹ Present address: Institute of Animal Resource Ecology, University of British Columbia, Vancouver 8, B. C. Canada.

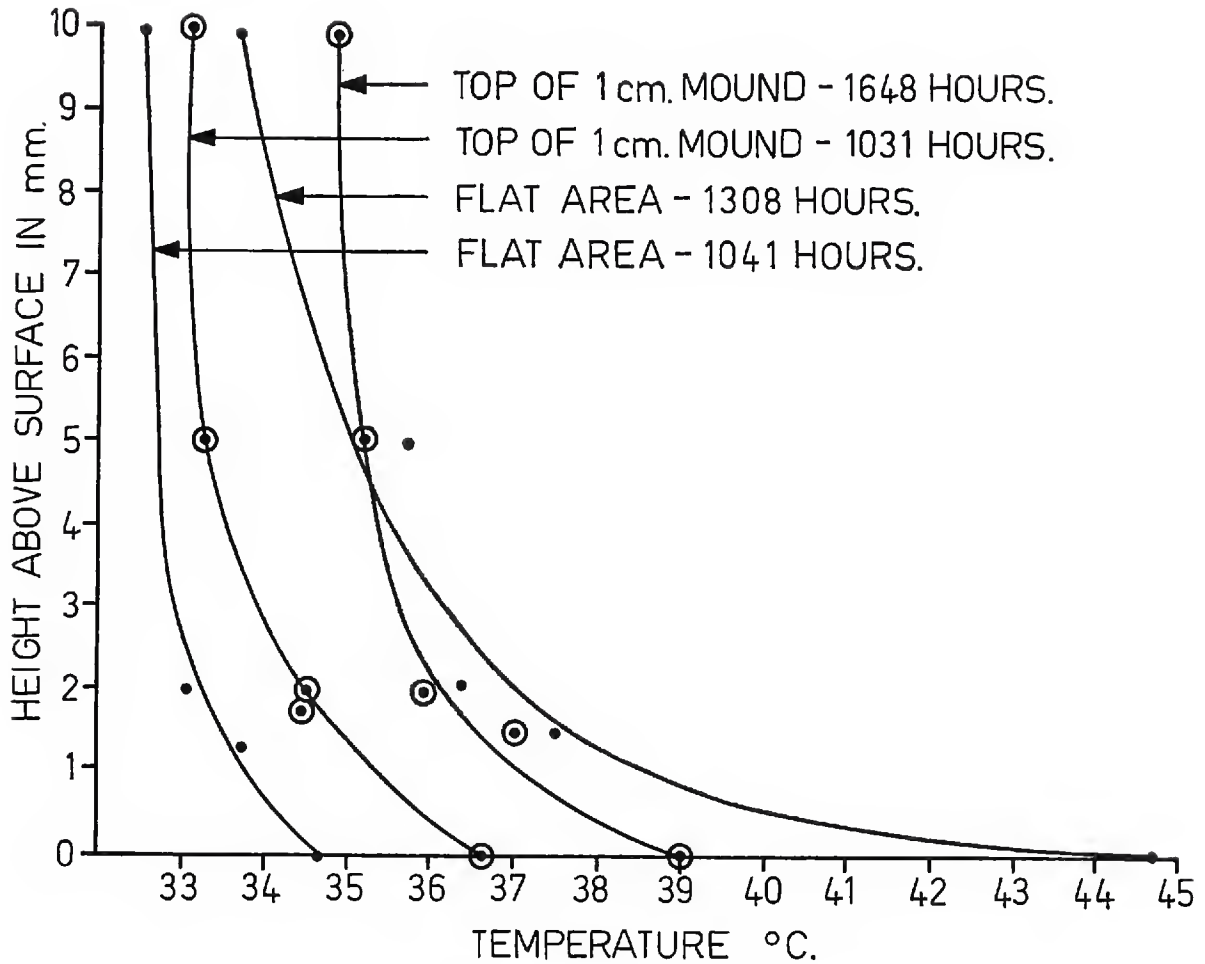


FIG. 1. Air temperature profiles on a typical day, 12 September 1969. The 1-cm mounds are where "thermoregulating" beetles perch.

C upper limit) and two number 403 thermistors. The small size (about 1 mm diameter) and short equalizing time (4 seconds) of these temperature probes permitted accurate temperature measurements of very small areas. Behavioral observations were mainly made with binoculars because beetles were so wary that usually no approach closer than two meters was possible.

THERMOREGULATORY BEHAVIOR

In the Sink winds of 0–5 mph normally prevail from the southwest and a thin superheated air layer less than 5 mm thick is produced just above the surface (Fig. 1). Living in such a warm environment, with daily summer surface temperatures ranging to above 50° C, both *Tanarthrus salinus* and *T. inyo* appear to have evolved two ways of avoiding heat stress. The first of these adaptations is morphological: the long, thin legs. The high surface-to-volume ratio of the legs in combination with their length minimizes the amount of heat which can be conducted through them from the ground to the body. In addition,

the long legs, when stretched, lift the body up out of the superheated air layer into the wind turbulence, as noted by the rocking of the bodies back and forth with the wind gusts. This "stilting" behavior moves the main body axis up from 1.5 to 4.0 mm above the surface in *T. salinus* and from 0.8 to 1.4 mm in *T. inyo*. Such small increases in height accompany relatively large decreases in surrounding air temperatures (Fig. 1), perhaps large enough to make a significant difference in the body temperatures of these small beetles when they approach their upper temperature tolerances. Stilting has also been observed in scorpions (Alexander and Ewer, 1958) and tenebrionid beetles (Hamilton, 1971) and has been thought to be related to thermoregulation.

Another factor may be important in determining the body temperature of these very small animals: solar radiation (Pepper and Hastings, 1952). Here the second apparent adaptation comes into play—behavioral thermoregulation. The stilting described above is invariably accompanied by: (1) standing immobile on top of a small mound of dirt, (2) positioning the body approximately parallel with the sun's rays, with the head toward the sun and the anterior end of the body elevated slightly, and (3) for *Tanarthrus salinus* only, the beige hind wings extending out over the black tip of the abdomen (see Fig. 2). The first two characteristics tend to minimize heat gain by (a) moving into cooler surrounding air and (b) decreasing the angle of incidence of sunlight on the body. Such orientation with respect to incident solar radiation has been noted in grasshoppers, butterflies, and other beetles and has been shown to be an important factor regulating rates of heat gain (Clench, 1966; Edney, 1971; Heinrich, 1972; Kevin and Shorthouse, 1970; Pepper and Hastings, 1952; Watt, 1968). Other cases of behavior aiding the avoidance of heat stress have been reported for reptiles (e.g. Hamilton and Coetzee, 1969; Norris, 1953; Willard, 1966). The third characteristic of the observed anthicid behavior, extension of the light-colored hind wings, essentially replaces a black surface with a more reflective one, thereby decreasing the amount of heat absorbed by that region. Edney (1971), Hamilton (1973) and others have shown that light-colored insect surfaces keep underlying tissues significantly cooler than tissues under dark surfaces. Although these results have been obtained for insects larger than the present anthicids, it is probable that the wing-extending behavior of *Tanarthrus salinus* can make a small but significant difference in body temperature when the insects are nearing their upper lethal temperatures. *Tanarthrus inyo* does not exhibit wing-extending behavior because its elytra extend to the end of the abdomen.

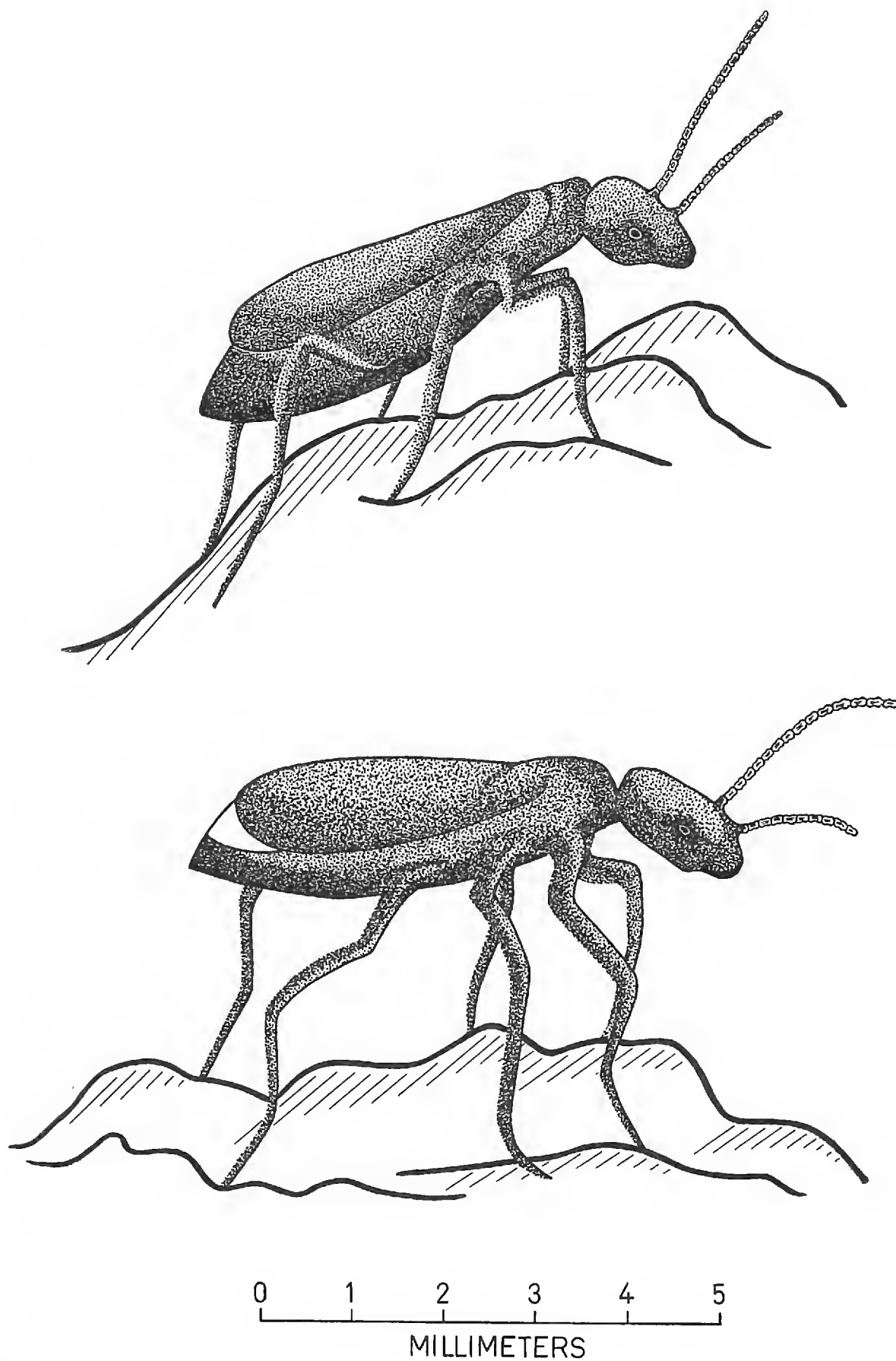


FIG. 2. *Tanarthrus salinus* in two stances, drawn from slides. Top figure is normal stance; bottom figure is "thermoregulatory" stance. Note the stretched legs and the hind wings out over the abdomen end.

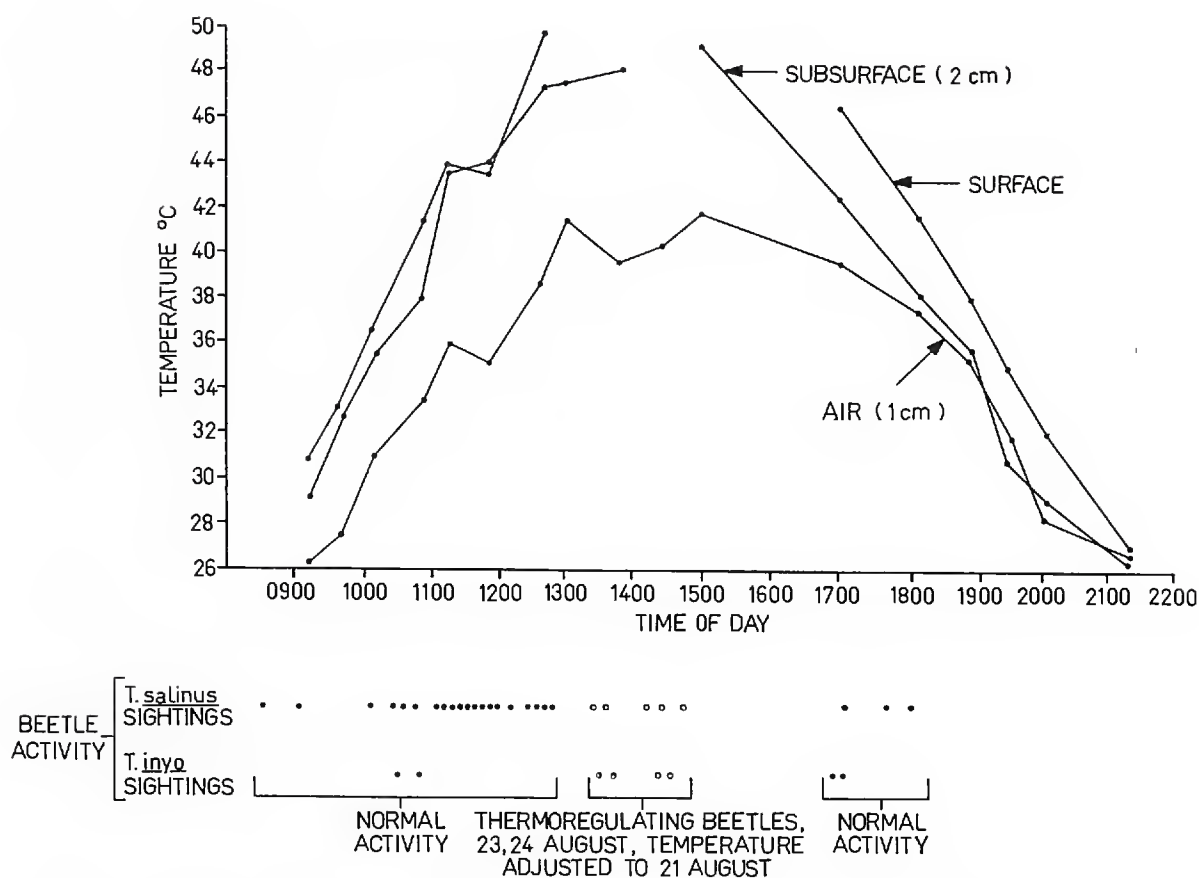


FIG. 3. Beetle activity periods and environmental temperatures on a typical day, 21 August 1969. In the beetle activity section at the bottom, one dot represents one sighting on that day at the indicated time.

Five observations support the hypothesis that the unusual behavior just described actually serves a thermoregulatory function (in the sense of avoiding a heat death, rather than maintaining a constant body temperature). The first is that normally the middle three or four hours of the day find no beetles above ground except in the shade of man-made objects. However, on the two hottest days experienced during the study, a total of 9 anthicids (5 of *T. salinus*) were seen on the surface in the midday period, and all were in the thermoregulatory postures (Fig. 3). The postures were not seen at any other time in the study for more than a few seconds. On the two hot days, these positions were maintained for up to 30 minutes. The beetles then disappeared when a duststorm struck the area on both days. Second, the beetles moved from this position only when the wind came up strongly, at which time they climbed down from their dirt perches to the shady side, only to climb back up when the wind died down, showing a definite favoring of this position. Third, just prior to the observed behaviors in the hot midday, literally dozens of both species flocked to the shade of the research facility (an open air shelter 3 m by 3 m), a phenomenon not seen previously in the

study. Fourth, the hind wings of *T. salinus* were extended over their black-tipped abdomens only when accompanied by the other characteristics of the apparent thermoregulatory behavior, and vice versa. Fifth, when exhibiting this unusual behavior, both species were much less wary than normal. They could be approached by an observer to within a few centimeters, suggesting that they may have been in critical thermal states.

These five observations strongly imply that the two species have evolved behavioral adaptations for avoiding heat death. Normally, when the surface gets too hot, they go underground. However, on exceptionally warm days, the subsurface may be too hot (present data are inconclusive) and they might then have to resort to extreme means to cool off above the surface. Schmidt-Nielsen (1964), Edney (1967), Hadley (1970), Stower and Griffiths (1966), and Pepper and Hastings (1952) have pointed out for small desert insects that evaporative cooling can only contribute a minute amount to overall heat loss. Therefore, the only cooling mechanisms available to such insects are behavioral and morphological. Actual body temperature data are needed to critically test the hypothesis of behavioral thermoregulation, but present circumstantial evidence at least fails to negate the hypothesis.

ACKNOWLEDGMENTS

Special thanks go to Dr. F. G. Werner for his prompt identification of the anthicids; Drs. C. J. Walters and W. R. Cothran kindly made comments on the manuscript, and B. Minchin rendered the figures.

LITERATURE CITED

- ALEXANDER, A. J. AND D. W. EWER. 1958. Temperature adaptive behaviour in the scorpion, *Opisthophthalmus latimanus* Koch. *J. Exp. Biol.*, 35: 349-359.
- CLENCH, H. K. 1966. Behavioral thermoregulation in butterflies. *Ecology*, 47(6): 1021-1034.
- EDNEY, E. B. 1967. Water balance in desert arthropods. *Science*, 156(2): 1059-1066.
1971. The body temperature of tenebrionid beetles in the Namib Desert of Southern Africa. *J. Exp. Biol.*, 55: 253-272.
- HADLEY, N. F. 1970. Micrometeorology and energy exchange in two desert arthropods. *Ecology*, 51(3): 434-444.
- HAMILTON, W. J. III. 1971. Competition and thermoregulatory behavior of the Namib Desert tenebrionid beetle genus *Cardiosis*. *Ecology*, 52(5): 810-822.
1973. *Life's Color Code*. McGraw-Hill, N. Y., 238 pp.
- HAMILTON, W. J. III AND C. G. COETZEE. 1969. Thermoregulatory behaviour of the vegetarian lizard *Anglosaurus skoogi* on the vegetationless northern Namib Desert dunes. *Sci. Pap. Namib Desert Res. Sta.*, 47: 95-103.

- HEINRICH, B. 1972. Thoracic temperatures of butterflies in the field near the equator. *Comp. Biochem. Physiol.*, 43A: 459-467.
- KEVIN, P. G. AND J. D. SHORTHOUSE. 1970. Behavioral thermoregulation by high arctic butterflies. *Arctic*, 23: 268-279.
- NORRIS, K. S. 1953. The ecology of the desert iguana *Dipsosaurus dorsalis*. *Ecology*, 34: 265-287.
- PEPPER, J. H. AND E. HASTINGS. 1952. The effects of solar radiation on grasshopper temperature and activities. *Ecology*, 33: 96-103.
- SCHMIDT-NIELSEN, K. 1964. *Desert Animals, Physiological Problems of Heat and Water*. Oxford Univ. Press, London, 277 pp.
- STOWER, W. J. AND J. F. GRIFFITHS. 1966. The body temperature of the desert locust (*Schistocerca gregaria*). *Entomol. Exp. Appl.*, 9: 127-178.
- WATT, W. B. 1968. Adaptive significance of pigment polymorphisms in *Colias* butterflies. I. Variation of melanin pigment in relation to thermoregulation. *Evolution*, 22: 437-458.
- WILLARD, D. E. 1966. The thermoeology of *Cnemidophorus tigris*. PhD Thesis, Zoology Dept., University of California at Davis.

ZOOLOGICAL NOMENCLATURE: Announcement A. (n.s.) 89

Required six-month's notice is given of the possible use of plenary powers by the International Commission on Zoological Nomenclature in connection with the following names listed by case number.

(see *Bull. Zool. Nomencl.* 29, part 1, 1 May 1972)

1944. Suppression of *Lyda inanis* Klug, 1808 (Insecta, Hymenoptera)

1979. Type-species for *Uloma* Dejean, 1821 (Insecta, Coleoptera)

(see *Bull. Zool. Nomencl.* 29, part 3, 30 November 1972)

1989. Type-species for *Anobium* Fabricius, 1775, *Grynobius* Thomson, 1859, and *Priobium* Motschulsky, 1845 (Insecta, Coleoptera)

1994. Type-species for *Dicyrtoma* Bourlet, 1842, and *Dicyrtomina* Börner, 1903; suppression of *Podura minuta* O. Fabricius, 1783, and *Papirius cursor* Lubbock, 1862; validation of *Papirius fuscus* Lubbock, 1873 (Insecta, Collembola)

1998. Type-species for *Deuterosminthurus* Börner, 1901 (Insecta, Collembola)

1999. Type-species for *Eusminthurus* Börner, 1900 (Insecta, Collembola)

(see *Bull. Zool. Nomencl.* 29, part 4, 29 December 1972)

1979. Type-species for *Phaleria* Latreille, 1802 (Insecta, Coleoptera)

1948. Validation of RIODINIDAE Grote, 1895 (Insecta, Lepidoptera)

2000. Suppression of *Ptenura* Templeton, 1842, and *Podura crystallina* Müller, 1776 (Insecta, Collembola)

2004. Suppression of *Dapanus* Hentz, 1867 (Araneae)

Comments should be sent in duplicate, citing case number, to the Secretary, International Commission on Zoological Nomenclature, c/o British Museum (Natural History), Cromwell Road, London SW7 5BD, England. Those received early enough will be published in the *Bulletin of Zoological Nomenclature*.—MARGARET DOYLE, *Scientific Assistant*.

**Chromosomal Variability in a Nearctic Lycaenid Butterfly,
*Philotes sonorensis***

(Lepidoptera: Lycaenidae)

THOMAS C. EMMEL, HOUSTON R. TREW, AND OAKLEY SHIELDS

*Department of Zoology, University of Florida, Gainesville 32601, and
Department of Entomology, University of California, Davis 95616*

Variable chromosome number has been reported in many plants and animals. Aside from polyploidy, it is clear that chromosomal loss, Robertsonian rearrangement including centric fusion, and supernumerary chromosomes represent the common modes of change in chromosome number in groups as diverse as the flowering plants (Lewis, 1970), grasshoppers (Kayano *et al.*, 1970; White *et al.*, 1964), fish (Ohno *et al.*, 1965), lizards (Gorman and Atkins, 1967; Gorman *et al.*, 1968), white-throated sparrows (*Zonotrichia*) (Thorneycroft, 1966), and mammals (Patton, 1969; Wahrman *et al.*, 1969). In groups with holokinetic chromosomes (e.g., butterflies and moths), fragmentation has been hypothesized as the chief factor leading to diversity of chromosome number (Emmel, 1972; Emmel and Trew, 1973). We report here extraordinary intraindividual as well as intrapopulation variability in butterfly karyotype, apparently resulting from chromosomal fragmentation at spermatogenesis.

MATERIAL AND METHODS.—The small lycaenid butterfly *Philotes sonorensis* Felder & Felder is found in scattered colonies in lowland areas of California, frequently in seasonally dry foothill canyons. It feeds on *Dudleya* (Crassulaceae) in the larval stages and flies as an adult in early spring. Samples of testes fixed in 3:1 absolute ethyl alcohol : glacial acetic acid were taken in 1970 and 1971 in three populations in Placer, El Dorado, and Stanislaus counties (43, 7, and 1 male specimens, respectively) and airmailed to the University of Florida for analysis. The testes were stained with lacto-aceto-orcein, squashed, observed and photographed under brightfield and phase (Emmel, 1969).

CYTOLOGICAL OBSERVATIONS AND DISCUSSION

In testes with dividing cells, meiosis appeared regular with pairing observed for all chromosomes (no univalents). One or more bivalents per karyotype were often composed of two smaller fragments synapsing with one large homologue in a tripartite bivalent (Fig. 1). Interestingly, Suomalainen (1969) has previously observed tripartite bivalents



FIG. 1. Pairing of apparent fragments with homologous chromosome in *Philotes sonorensis*. (a) Metaphase I, tripartite bivalent; (b) orientation of triple chromatid on spindle in late metaphase I. Redrawn from photographs; approx. 7200 \times and 3600 \times .

(but no chiasmata) in females of the pyralid moth *Witlesia murana* Curt., indicating that fragmentation of moth chromosomes also occurs in nature.

Chromosome numbers ranging from $n = 17$ to 44 were found in populations surveyed (Fig. 2), with the modal number being 22 in the Placer County populations, 23 in the El Dorado County population, and 19 in the single male from the Stanislaus County population. Of the largest sample, the 13 Placer County males with clearly observable dividing cells, 7 (54 per cent) had multiple karyotypes. Four had $n = 22$ and 24 cells, and one had numerous meiotic cells ranging from $n = 22$ to 31. This great intraindividual variability was also found in the other sampled populations (Table 1). Cells with the higher chromosome number had smaller chromosomes in all cases.

Lesse (1960, 1969) found great chromosomal variability in populations of species of the Palearctic lycaenid butterfly genera *Lysandra* and *Agrodiaetus*, but until now there was no indication of its presence in any Nearctic butterflies. In the few Nearctic lycaenids surveyed to date (Maeki and Remington, 1961), the haploid number tends to be 24, with no intraindividual or intraspecies variation.

The selective significance of numerical chromosomal variability of this type would seem to lie first in the promotion of flexibility in the genotype's ability to respond to variable environment conditions. Unpublished observations we have made on the cytogenetics of other butterfly species demonstrate a very low chiasma frequency (usually two chiasmata per bivalent) in spermatogenesis and Suomalainen (1969) has previously reported a lack of chiasmata in oogenesis in Lepidoptera. The restriction on genetic exchange through crossing over would promote a low recombination index (Darlington, 1939) in Lepidoptera unless other factors were operating. It is clear that the high chromosome number (modal number being about $n = 31$) in moths and butterflies

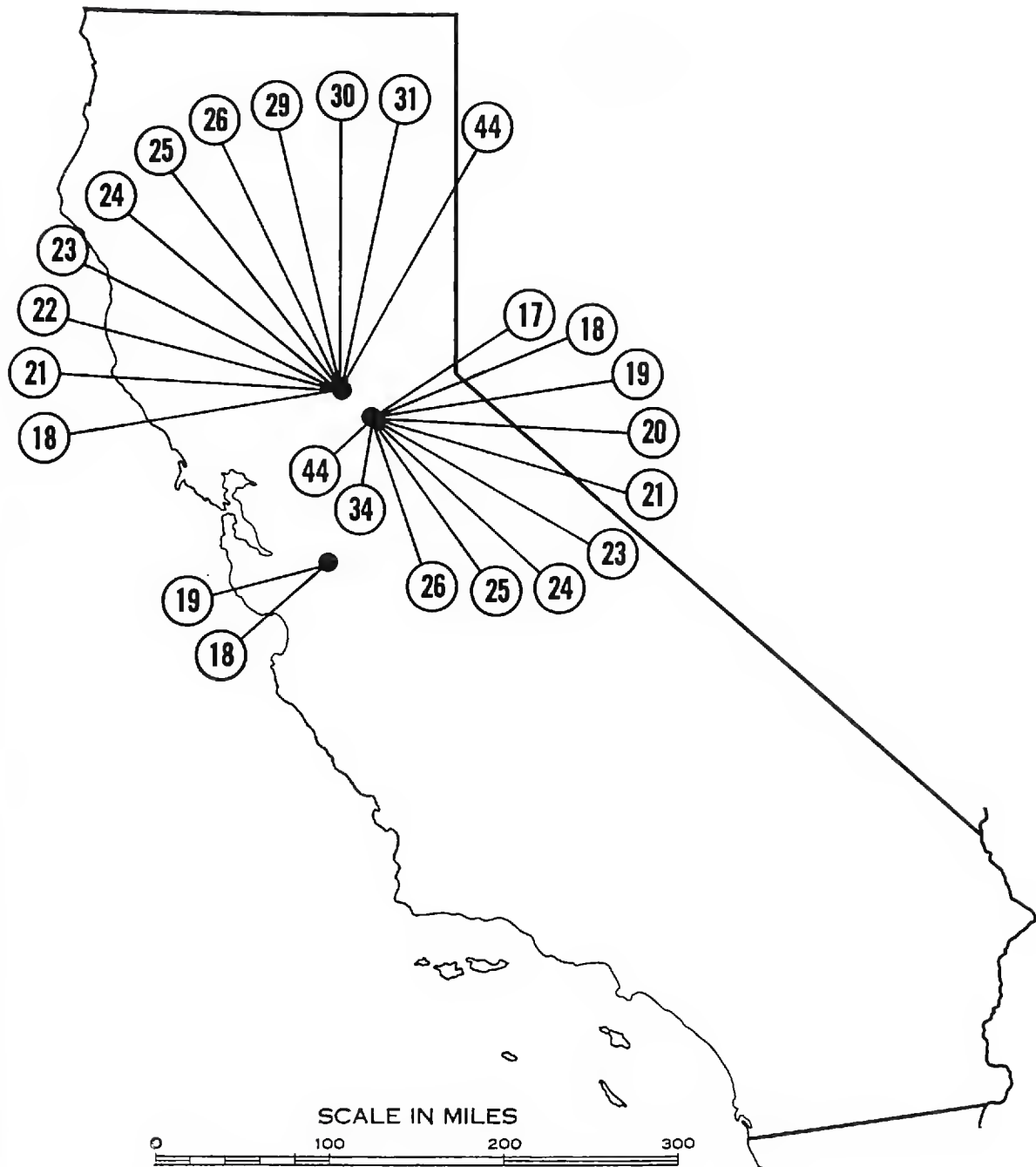


FIG. 2. The geographic relationships of three *Philotes sonorensis* populations in the state of California, showing variability in haploid number (n) of chromosomes found in males of each population. From north to south: Placer County (3-4 mi. N.E. of Auburn along Middle Fork of American River, 21 February 1970 and 13-14 February 1971); El Dorado County (4 mi. N. of Placerville on California Highway 193 at South Fork of the American River, 21 February 1970); Stanislaus County (18 mi. W. of Interstate Highway 5, Del Puerto Canyon, 7 March 1970).

as a group would compensate for this trend. The observations reported here offer evidence that fragmentation of butterfly chromosomes does occur in nature and that the holokinetic nature of the lepidopteran chromosome allows successful diakinesis in such cases.

The data from the present study and from Lesse (1960, 1969) also provide evidence for the suggestion that lepidopteran species in marginal

TABLE 1. Multiple Genotypes in Male Individuals of Three California Populations of *Philotes sonorensis* (bold-face type indicates median chromosome number for population sample).

Population ¹	No. of individuals with cells having chromosome number (<i>n</i>) of															Total No. Cells Counted (Individuals)
	17	18	19	20	21	22	23	24	25	26	29	30	31	34	44	
Placer County		1			3	10	2	2	1	1	1	1	1		4	50 (13)
El Dorado County	1	1	1	1	1		1	1	1	1				1	1	99 (4)
Stanislaus County		1	1													47 (1)

¹ See Fig. 1 legend for exact location of population. All counts (including $n = 44$) verified in Meiosis I (usually metaphase I) where chromosomes were still paired.

habitats or habitats with high environmental stress, such as *Philotes* in the dry foothill areas of California and *Lysandra* in certain areas of Spain, may often exhibit fragmentation of their chromosomes, promoting increased genetic flexibility. Such increased variability of supernumerary chromosomes has been found in marginal weedy populations of the plant *Claytonia virginica* L. (Lewis *et al.*, 1971), where bivalents form normally and meiosis is not upset. (The cytogenetics of this situation are not completely understood as yet.) Because of the holokinetic nature of lepidopteran chromosomes, however, their fission products can successfully synapse and segregate at meiosis. It would be predicted that such dramatic reassortment of the genotype through fragmentation should occur in other stress situations, as in rapid evolution of phenotypically polymorphic mimetic systems in Lepidoptera. Evidence for numerical polymorphism is accumulating for the genus *Heliconius*, especially *H. doris* (L.), which commonly participates in mimicry complexes in South and Central America (Emmel, in preparation).

A possible coevolutionary feature of this chromosomal variability in *Philotes* is the polyploidy ($n = 17, 34, 51, 68$) found in the two *Dudleya* subgenera that *P. sonorensis* larvae use as hosts (Moran, 1951; Moran and Uhl, 1952; Uhl and Moran, 1953). Hybridization between host species is common. The small seeds of *Dudleya* are viable only a short time and are not adapted for long-range dispersal; hence the host colonies are usually quite isolated. Adult *Philotes sonorensis* have been shown to have a restricted home range in an extensive mark-recapture study (Keller *et al.*, 1966; Mattoni and Seiger, 1963). It would thus appear that the butterfly is closely linked to its foodplant and some of the same factors that make polyploidy of selective value in *Dudleya* may be preserving gains and losses of chromosomes in *Philotes*.

ACKNOWLEDGMENTS

This research was supported by the National Science Foundation (grants GB-8442 and GB-32151 to T.C.E.), the U. S. Public Health Service through Biomedical Sciences Research Grant 71-59 from the Division of Sponsored Research, University of Florida (T.C.E. and H.R.T.), and an NSF graduate traineeship (O.S.). We thank F. C. Johnson, University of Florida, and Dr. John F. Emmel, University of California Medical School at San Francisco, for critical comments on the manuscript. Population samples were collected by O. Shields and R. Wells.

LITERATURE CITED

- DARLINGTON, C. D. 1939. The evolution of genetic systems. Cambridge Univ. Press, Cambridge, 149 pp.
- EMMEL, T. C. 1969. Methods for studying the chromosomes of Lepidoptera. *J. Res. Lepidoptera*, 7: 23-28.
1972. Mate selection and balanced polymorphism in the tropical nymphalid butterfly, *Anartia fatima*. *Evolution*, 26: 96-107.
- EMMEL, T. C. AND H. R. TREW. 1973. The chromosomes of skipper butterflies from southwestern North America (Lepidoptera, Hesperiiidae). *Cytologia*, (in press).
- GORMAN, G. C. AND L. ATKINS. 1967. The relationships of the *Anolis* of the *roquet* species group (Sauria: Iguanidae). II. Comparative chromosome cytology. *Syst. Zool.*, 16: 137-143.
- GORMAN, G. C., R. THOMAS, AND L. ATKINS. 1968. Intra- and interspecific chromosome variation in the lizard *Anolis cristatellus* and its closest relatives. *Breviora*, 293: 1-13.
- KAYANO, H., M. SANNOMIYA, AND K. NAKAMURA. 1970. Cytogenetic studies on natural populations of *Acrida lata*. I. Local variation in the frequency of B-chromosomes. *Heredity*, 25: 113-122.
- KELLER, E. C., JR., R. H. T. MATTONI, AND M. S. B. SEIGER. 1966. Preferential return of artificially displaced butterflies. *Anim. Behav.*, 14: 197-200.
- LESSE, H. DE. 1960. Spéciation et Variation Chromosomique chez les Lépidoptères Rhopalocères. *Ann. Sci. Natur., Zool. (Paris)*, 12^e serie, II: 1-223.
1969. Les Nombres de Chromosomes dans le Groupe de *Lysandra coridon* (Lep. Lycaenidae). *Ann. Soc. Entomol. France (N.S.)*, 5: 469-522.
- LEWIS, W. H. 1970. Chromosomal drift, a new phenomenon in plants. *Science*, 168: 1115-1116.
- LEWIS, W. H., R. L. OLIVER, AND T. J. LUIKART. 1971. Multiple genotypes in individuals of *Claytonia virginica*. *Science*, 172: 564-565.
- MAEKI, K., AND C. L. REMINGTON. 1961. Studies on the chromosomes of North American Rhopalocera. 3. Lycaenidae, Danainae, Satyrinae, Morphinae. *J. Lepidoptera Soc.*, 14: 127-147.
- MATTONI, R. H. T., AND M. S. B. SEIGER. 1963. Techniques in the study of population structure in *Philotes sonorensis*. *J. Res. Lepidoptera*, 1: 237-244.
- MORAN, R. V. 1951. A revision of *Dudleya* (Crassulaceae). Unpubl. Ph.D. dissertation, Univ. of Calif., Berkeley.
- MORAN, R. V., AND C. H. UHL. 1952. Four natural hybrids in *Dudleya*. *Desert Plant Life*, 24: 28-42.
- OHNO, S., C. STENIUS, E. FAISST, AND M. T. ZENZES. 1965. Post-zygotic chromosomal rearrangements in rainbow trout (*Salmo irideus* Gibbons). *Cytogenetics*, 4: 117-129.
- PATTON, J. L. 1969. Chromosome evolution in the pocket mouse, *Perognathus goldmani* Osgood. *Evolution*, 23: 645-662.
- SUOMALAINEN, E. 1969. Chromosome evolution in the Lepidoptera. In Darlington, C. C., and K. R. Lewis, eds., *Chromosomes today*, Volume Two, Oliver and Boyd, Edinburgh, pp. 136-137.

- THORNEYCROFT, H. B. 1966. Chromosomal polymorphism in the white-throated sparrow, *Zonotrichia albicollis* (Gmelin). *Science*, 154: 1571-1572.
- UHL, C. H., AND R. V. MORAN. 1953. The cytotaxonomy of *Dudleya* and *Hasseanthus*. *Amer. J. Bot.*, 40: 492-502.
- WAHRMAN, J., R. GOITEIN, AND E. NEVO. 1969. Mole rat *Spalax*: evolutionary significance of chromosome variation. *Science*, 164: 82-84.
- WHITE, M. J. D., H. L. CARSON, AND J. CHENEY. 1964. Chromosomal races in the Australian grasshopper *Moraba viatica* in a zone of geographic overlap. *Evolution*, 18: 417-429.

SCIENTIFIC NOTE

Notes on the Distribution and Ecology of *Scaphinotus bilobus* (Coleoptera:Carabidae).—According to Lindroth (1961. *Opusc. Entomol. Suppl.*, 20: 1-200), "the species is rare and its demands little known." This species is mainly northeastern and it is distributed south to Illinois, Missouri, Ohio, and Catskill Mountains, N.Y., west to Nebraska. In Canada, Lindroth records this ground beetle from Nova Scotia, Québec (a single locality), Ontario and Manitoba.

The species is not uncommon in southern Québec (south of 50° N Lat.). In the locality records, the following abbreviations were used to indicate the collections in which the specimens are located: AL—André Larochelle Collection, Rigaud; CC—Claude Chantal Collection, Québec; CH—Cercle Harricana Collection, Amos; JCA—Jean-Charles Aubé Collection, Québec; JPL—Jean-Paul Laplante Collection, Sainte-Foy; LEM—Lyman Entomological Museum, Sainte-Anne-de-Bellevue; LRF—Laboratoire de Recherches Forestières Collection, Sainte-Foy; UM—Université de Montréal Collection, Montréal. The distribution of *Scaphinotus bilobus* Say in Québec is: Abitibi Co., Amos, 13 May 1962 (1, CH); Chapais, 11 August 1972 (2, AL); Chibougamau, 23 September 1968 (2, CC) and 12 August 1972 (1, AL); Lac Chicobi, 21 June 1968 (2, AL); La Ferme, 26 May 1963 (1, UM); Lebel-sur-Quévillon, 16 July 1968 (3, AL); Matagami, 20 June 1968 (3, AL); Saint-Mathieu, 1 July 1964 (1, CH); Senneterre, 12 July 1968 (1, AL); Val-d'Or, 11 July 1968 (2, AL). Champlain Co., Lac Normand, 27 August 1969 (2, CC). Charlevoix-Est Co., Baie-Sainte-Catherine, 28 June 1969 and 1970 (10, AL; 2, CC). Charlevoix-Ouest Co., Baie-Saint-Paul, 13 September 1969 (1, CC). Frontenac Co., Woburn, 2 September 1955 (2, JPL). Lotbinière Co., Saint-Sylvestre, 14 July 1967 (1, JCA). Matane Co., Métis-sur-Mer, 18 August 1889 (2, LEM). Montmorency No. 1 Co., Grand Lac Jacques-Cartier, 31 August 1968 (1, CC). Saguenay Co., Tadoussac, 14 June 1971 (2, AL). Saint-Maurice Co., Lac Caousacouta, 21 June 1965 (2, JPL), 17 July 1968 (1, LRF), 22 July 1965 (1, LRF) and 23 September 1965 (4, JPL; Lindroth, 1969. *Opusc. Entomol. Suppl.* 34: 945-1192). Témiscamingue Co., Tabaret, 5 May 1968 (1, AL).

This species is confined to shaded, rather moist places, especially coniferous and mixed forests, on banks of lakes and rivers. During the day hiding under dead leaves and logs, it often invades the river banks, peat-bogs and clearings in the night in search of snails. Associated ground beetles include: *Agonum retractum* LeConte, *Calathus ingratus* Dejean, *Pterostichus adstrictus* Eschscholtz, *Pterostichus coracinus* Newman, *Pterostichus punctatissimus* Randall and *Sphaeroderus nitidicollis brevoorti* LeConte.—ANDRÉ LAROCHELLE, *Collège Bourget, C. P. 1000, Rigaud, Québec.*

PACIFIC COAST ENTOMOLOGICAL SOCIETY

D. G. DENNING
President

J. A. CHEMSAK
President-elect

M. S. WASBAUER
Secretary

P. H. ARNAUD, JR.
Treasurer

PROCEEDINGS

THREE HUNDRED AND FORTY-FOURTH MEETING

The 344th meeting was held Friday, 18 February 1972 in the Morrison Auditorium of the California Academy of Sciences, Golden Gate Park, San Francisco, with President Denning presiding.

Members present (40): F. G. Andrews, C. Armin, P. H. Arnaud, Jr., W. Azevedo, J. W. Bass, G. S. Benham, Jr., F. L. Blanc, R. M. Bohart, T. Briggs, R. M. Brown, G. Buckingham, Cathy Cheap, S. Clement, Karen Corwin, D. G. Denning, A. R. Dutton, J. G. Edwards, J. F. Emmel, C. Farrell, W. E. Ferguson, M. R. Gardner, Lauren Green, E. Grissell, K. S. Hagen, E. A. Kane, B. Keh, R. L. Langston, H. B. Leech, R. W. Lem, A. E. Michelbacher, J. Powell, E. S. Ross, J. Shepard, R. E. Stecker, Barbara Trowbridge, D. Ubick, M. S. Wasbauer, S. C. Williams, D. Y. Wong, R. L. Wong.

Visitors present (22): Fern Blanc, R. Buckerly, Caroline Caw, R. Coville, Phyllis Emmel, Stephenie Ferguson, B. and D. Grushkowitz, L. M. Halverson, R. Hollingsworth, Netta and Susanne Leong, Carolyn Mullinex, M. Narasaki, Reny and Taly Slay, D. Strike, S. Szerlip, Barbara Ware, A. Wong, R. Wong, Virginia Woo.

The minutes of the meeting held 17 December 1971 were summarized.

President Denning called for announcements. Dr. Stecker announced that the tear sheets from the first 20 volumes of the *Pan-Pacific Entomologist* on Coleoptera are out and will be on sale after the meeting. There are 75 articles and they will be priced at \$0.05 each.

Dr. Ferguson announced that the program committee would be grateful for any suggestions on future speakers for Society meetings and especially for possible sites and times for the annual field day and picnic.

Mr. Jon Shepard announced that Mr. Scott Ellis of Colorado will be collecting in the Four Corners area of Colorado, Utah and Arizona this coming summer and would like to know if anyone would be interested in buying material he collects.

Mr. Leech announced the appearance of Hatch's latest and final volume of the *Beetles of the Pacific Northwest*. This volume includes the buprestids, chrysomelids, weevils, cerambycids and other families.

Dr. J. A. Powell announced the appearance of Volume 13 of the *Bulletin of the California Insect Survey* by Bohart and Horning which treats the bembicine sand wasps of California, and includes the genera *Bembix*, *Bicyrtes* and *Microbembix*, a total of eighteen species.

Dr. Powell also commented on the butterfly, *Nymphalis californica*, which he had discussed at an earlier meeting. There was a great build-up in numbers of this species at Mt. Shasta last summer so that by the fall of the year they were migrating and were seen in the Bay Area. At that time, Dr. Powell asked anyone who witnessed numbers of the butterfly to contact him. He mentioned the possibility of their overwintering in this area and going through a couple of generations

here, although normally large populations do not occur here. He stated that he had observed some overwintering under bark this season in the Berkeley Hills. They are currently flying there in good numbers but apparently with no directional movement. Directional movement by the species appears to be in response to population density. He again requested anyone who witnesses large populations of this butterfly this spring and summer, especially if flying in a pattern of directional movement, to contact him.

Dr. Ferguson mentioned having collected caterpillars of *Nymphalis californica* at Escondido last spring. They all died and the one submitted to the insect pathology lab at Berkeley was reported killed by a bacterium never before recorded from butterflies of that species. He noted that it would be interesting to find out if the bacterium is a common natural agent in the biotic control of *Nymphalis californica*.

The following notes were presented:

A remarkable Tabanid inhabitant of an ant nest in western Washington—natural or accidental?—A year ago this month (20 February 1971), a graduate student, Gary Alpert, at Washington State University, Pullman, discovered two mature larvae of *Tabanus* sp. in the center of a nest of the western mound-thatching ant, *Formica obscuripes*, which he was exploring in his studies on local ants. In this portion of the nest, there were a few other denizens such as isopods and collembolans. The mound was situated among growing vines and under trash from trimmings of blackberries in the vicinity of Walla Walla, Washington.

On return to his laboratory, Alpert succeeded in rearing one of the larvae to the pupal stage from which a large, dark horsefly emerged on 24 April. This, together with the other preserved larva, was mailed to me in May for identification, but unfortunately, the fly and pupal case were broken into small fragments in transit. It was possible to ascertain from the bits and pieces, that the fly was a large black, bare-eyed *Tabanus* male of some resemblance to, but not, *Tabanus kesseli* Philip, known on the Pacific Coast as far north as southern British Columbia; the upper eye facets are a little larger, as in *T. kesseli* than in related *T. aegrotus* O. S. Fragments of the pupa indicate an unusually long-spined form, perhaps habitat-oriented.

The purpose of this cursory note is to alert others to this possible special habitat of an obscure or perhaps unknown tabanid species. Customary breeding in tree-holes by certain bizarre tabanids in tropical Africa and of *Leucotabanus ambiguus* Stone, in frass-filled termite galleries in rotting trunks of old, living willows, discovered recently by Dr. John Burger of Tucson, Arizona, are notable unusual tabanid breeding sites. I am not aware, however, of reported tabanid occupation of ant hills, at least in the New World, which stimulates speculation on the natural cycle—oviposition, larval development, pupation, and any traversal of the ant-occupied periphery of the nests, if this is a customary, and not an accidental, eco-niche. In the words of the collector, "The tabanid larvae came from the center of the nest where the ant activity was high"! Although the nest mound was located about 15 yards above a small pond, it seems unlikely that two mature larvae would have migrated to this special situation from the pond margin to complete their development.—CORNELIUS B. PHILIP, *California Academy of Sciences, San Francisco*.

***Meigenielloides cinereus* (Diptera: Tachinidae) reared from *Gamarotettix bilobatus* (Orthoptera: Gryllacrididae).**—The genus *Meigenielloides* Townsend is one of 43 North American (north of Mexico) genera assigned

to the tachinid tribe Blondeliini. The hosts for this tribe include larvae of Lepidoptera, Coleoptera, and tenthredinid Hymenoptera. It is of considerable interest to report the rearing of *Meigenielloides cinereus* (Townsend) from the Orthopteran family Gryllacrididae on the basis of two rearings, both of which were made at Mill Valley, Marin County, California.

The first rearing (deposited in the collection of the California Academy of Sciences) was made by Thomas S. Leech from a female adult specimen of *Gammarotettix* probably *bilobatus* (Thomas) (det. A. B. Gurney, 1957). Two tachinid larvae emerged from the host and pupated on 29 May 1957. One adult male of *Meigenielloides cinereus* issued on 14 June 1957, and a fly did not issue from the second puparium.

The second rearing (deposited in the collection of the author) was made by Thomas W. Davies from an adult female of *Gammarotettix bilobatus* (Thomas) (det. David C. Rentz). On 20 June 1967 a tachinid larva emerged from the host and pupated. An adult female of *Meigenielloides cinereus* issued on 7 July 1967.

In both rearings the pupal period lasted about two and one half weeks (17 days).—PAUL H. ARNAUD, JR., *California Academy of Sciences, San Francisco.*

The status of *Loxosceles unicolor* in Tesla Canyon.—In November 1969, the late Dr. J. W. MacSwain, of the University of California, gave a report entitled, "A Naturalist Returns to Tesla Canyon." (Pan-Pac. Entomol. 46(1):74-75, 1970.) In his report Dr. MacSwain mentioned that on one of his 1951 collecting trips he collected ". . . numerous *L. unicolor* . . . around or in the sides of the canyon . . ." Further, he implied that the spider still existed there on his last collecting trip on 26 October 1969. If valid, this report would represent the northern-most record of *L. unicolor* in the San Joaquin Valley.

I talked with Dr. MacSwain about the occurrence and there was no doubt that these spiders were found in the canyon, and that he had collected them there on several occasions. I then checked with Dr. E. I. Schlinger about the spider samples given him by Dr. MacSwain which were collected 26 October 1969. Dr. Schlinger said there were no *Loxosceles* in those samples.

I have made several collecting trips to Tesla Canyon, working the entire length on both sides, including the places where Dr. MacSwain said he collected and on the Lawrence Radiation Laboratory property. Although many spiders resembling violin spiders were found I have yet to collect *Loxosceles* spiders in Tesla Canyon and so far the available evidence does not support the claim made by Dr. MacSwain. The most northerly collection of *L. unicolor* on the west side of San Joaquin Valley is in Jacalitos Canyon, about 5 miles south of Coalinga, Fresno County, California (collectors: R. R. Snelling, 1967; F. Ennik, 1970).—FRANKLIN ENNIK, *California Department of Public Health, Bureau of Vector Control, Berkeley.*

The principal speaker of the evening was MR. MICHAEL R. GARDNER, Systematic Entomologist, California Department of Agriculture. His illustrated talk was entitled, "Ecological and Behavioral Relationships of Millipeds in California."

Coffee and other refreshments were served at a social hour in the entomology rooms following the meeting.—M. S. WASBAUER, *Secretary.*

THREE HUNDRED AND FORTY-FIFTH MEETING

The 345th meeting was held Friday, 21 April 1972, in the Morrison Auditorium of the California Academy of Sciences, Golden Gate Park, San Francisco, with President Denning presiding.

Members present (41): F. G. Andrews, P. H. Arnaud, Jr., J. W. Bass, G. S. Benham, Jr., G. Brady, D. Briggs, T. Briggs, M. Browning, R. Bushnell, Karen S. Corwin, R. Coville, H. V. Daly, T. Delgman, J. G. Edwards, Beverly Ehreth, F. Ennik, W. E. Ferguson, A. J. Gilbert, B. W. Grushkowitz, J. Guggolz, K. S. Hagen, E. A. Kane, B. Keh, W. H. Lange, R. L. Langston, H. B. Leech, R. Lem, W. W. Middlekauff, R. H. Peterson, C. B. Philip, H. G. Real, G. Rotrammel, S. L. Szerlip, K. Taylor, R. Thorp, R. Toth, D. Ubick, D. Voegtlin, K. R. Wald, D. Y. Wong, R. L. Wong.

Visitors present (19): J. Baier, Lily Dong, J. T. Doyen, Stephenie Ferguson, Marcia Gilbert, Dorothy Grushkowitz, R. Hall, Lucia Hui, M. Jensen, S. Germanovitch, J. B. Kimsey, Mrs. J. B. Kimsey, Netta Leong, Susanne Leong, W. Minkel, R. P. Papp, Norma E. Papp, Joyce Thorp, Virginia Woo.

The minutes of the meeting held 18 February 1972 were summarized.

The following notes were presented:

Mass movement of *Sympetrum corruptum* (Hagen) at Pacifica, California (Odonata: Libellulidae).—Observations on the unidirectional mass movements of the dragonfly *Sympetrum corruptum* (Hagen) have been reported in the Kensington-Albany-Berkeley and Mill Valley areas by Turner (1965, Pan-Pac. Entomol. 41:66-67), and Opler (1971, Pan-Pac. Entomol. 47:223). A further record of a flight south of these previous recorded localities is presented. On 24 September 1970, Mrs. Jose Sanchez of 452 Heathcliff Drive, Pacifica, San Mateo County, California, first telephoned the Academy at 2:10 p.m. (P.D.T.) to report that for the past two hours there had been what she considered "thousands" of dragonflies in the air above where she lives. They were flying at a height so that it was impossible to catch them without a long-handled net. At 3:50 p.m., she telephoned to say that dragonflies were also very common at the Fairmont Elementary School. One specimen which was hit in the schoolyard and collected by one of her children was determined by Dr. Dennis E. Paulson as a male (young specimen) of *Sympetrum corruptum* (Hagen). It is presumed that this specimen was representative of the species involved in this flight. It is to be regretted that additional voucher specimens are not available. Mrs. Sanchez commented that this was the first flight of Odonata that she had observed in her five years residence in Pacifica.—PAUL H. ARNAUD, JR., *California Academy of Sciences, San Francisco.*

Hjelle scorpion collection donated to California Academy of Sciences.—Mr. John T. Hjelle, has recently donated his collection of 712 specimens of scorpions from northern California to the Department of Entomology, California Academy of Sciences.

This collection contains the types and specimens which formed the basis of his publication "Scorpions of the northern California coast ranges (Arachnida: Scorpionida)" which was published in 1972 (Occas. Pap. Calif. Acad. Sci., No. 92, 59 pages, 52 figures). It contains 202 type specimens: the holotype, allotype, and 162 paratypes of *Vaejovis gertschi striatus* Hjelle; the holotype, allotype, and 17 paratypes of *Uroctonus glimmei* Hjelle; and the holotype, allotype, and 17 paratypes of *Uroctonus mordax pluridens* Hjelle. In addition, there are 249 specimens of *Paruroctonus silvestrii* (Borelli), 4 *Superstitionia donensis* Stahnke, 255 *Uroctonus mordax mordax* Thorell, and 2 *Uroctonus* new species. This collection will complement the extensive series of scorpions being received from Dr. Stanley C. Williams. Because of these and other important donations, the

Academy's collection of Scorpionida is one of the world's largest.—P. H. ARNAUD, JR., *California Academy of Sciences, Golden Gate Park, San Francisco.*

The principal speaker of the evening was DR. JERRY A. POWELL, Department of Entomology, University of California, Berkeley. His illustrated talk was entitled: "Diverse adaptations to arid habitats by ethmiid moths."

Coffee and other refreshments were served during a social hour in the entomology rooms following the meeting.—M. S. WASBAUER, *Secretary.*

THREE HUNDRED AND FORTY-SIXTH MEETING

The 346th meeting was the annual field day and picnic. It was held on Saturday, 20 May 1972, at Castle Rock Park near Mt. Diablo, Contra Costa County, California.

Members present (12): J. E. Cronin, H. V. Daly, Jr., H. V. Davis, D. G. Denning, R. Dutton, W. E. Ferguson, J. R. Gabel, E. G. Linsley, W. W. Middlekauff, C. B. Philip, M. S. and Joanne S. Wasbauer.

Visitors present (13): Marcia Cronin, Loretta Denning, Pamela Dutton, Natasha Field, Juanita Linsley, Gladys Philip, D. W. Price, Duane Price and children, K. Washbauer.

The day was overcast and cool, but did not prevent picnicking on the wooden benches provided. Insects were not in evidence abundantly but Drs. Daly and Price brought a group of entomology students from the University of California, Berkeley, who collected, in addition to other things, a series of the Acrocerid fly, *Eulonchus* sp. from sticky-monkey flowers, *Mimulus aurantiacus*. Dr. Daly was nearly successful in collecting a specimen of an ant-mimic mirid bug, probably *Dacerla inflata* (Uhler).—M. S. WASBAUER, *Secretary.*

THREE HUNDRED AND FORTY-SEVENTH MEETING

The 347th meeting was held Friday, 20 October 1972, in the Morrison Auditorium of the California Academy of Sciences, Golden Gate Park, San Francisco, with President Denning presiding.

Members present (42): R. P. Allen, J. R. Anderson, F. G. Andrews, C. Armin, P. H. Arnaud, Jr., A. D. Bacon, D. J. Burdick, R. Bushnell, R. M. Brown, S. Clement, Karen Corwin, C. Dailey, D. G. Denning, J. G. Edwards, F. Ennik, W. E. Ferguson, A. J. Gilbert, A. R. and L. R. Gillogly, C. Goodpasture, E. Grissell, A. R. Hardy, S. Haskett, L. Hawkins, T. E. Hewton, Jr., E. Kane, B. Keh, H. B. Leech, A. E. Michelbacher, R. Peterson, J. A. Powell, R. F. Schoeppner, R. Stecker, S. Szerlip, R. L. Tassan, R. W. Thorp, B. Villegas, M. S. Wasbauer, S. P. Welles, Jr., R. H. Whitsell, S. C. Williams, D. L. Wilson.

Visitors present (39): H. P. Allmendinger, L. Bezoh, G. Brady, Carolyn Cain, Linda Campbell, Carolyn Dailey, Chris Duncan, Priscilla Ewing, Janie Edwards, Stephenie Ferguson, Marcia Gilbert, Gwen Gillogly, Mr. and Mrs. B. W. Grushkowitz, D. Guiliani, Debbi Hains, R. M. Haradon, Jr., Wanda Hardy, A. Koplan, J. Krug, Val Landwehr, R., D. and B. Merritt, Martha Michelbacher, R. P. Papp, R. Pemberton, Jane Rosemarin, W. E. Savary, R. E. Somerby, Chris Springer, Wilfred Sumner, M. A. Taylor, Joyce Thorp, Martha Usinger, J. F. Wells, D. Whitman, J. D. Wright, W. Yu.

The minutes of the meetings held 21 April and 20 May were summarized.

The following individuals were proposed for membership in the Society. Student membership: H. P. Allmendinger, M. Browning, D. Chandler, B. W. Grushkowitz, W. N. Mathis, R. Papp, J. R. Sawbridge. Regular membership:

J. A. Burnett, J. L. Gillespie, R. Goertzen, R. M. Haradon, Jr., W. W. Klopp, R. J. McCrea, J. D. Pinto, R. Schick, W. S. Sibray, A. C. Smith, R. S. Toth.

Dr. Daly gave a brief resume of how the R. L. Usinger Autobiography came into being, and suggested that the book would be inspirational reading for young people who were thinking of careers in the natural sciences. He suggested that members contact their local public libraries and ask that the book be placed on their shelves.

President Denning then introduced Mrs. R. L. Usinger who gave sincere thanks to all involved in the production of the autobiography. She also thanked the membership for its support and for the specially bound presentation copies given to the immediate members of the Usinger family. She pointed out that her late husband did not conceive of the book or put it down on tape with the idea in mind of having it published, but rather to leave a chronicle of his life for his family members.

The following notes were presented:

Notes on a mass flight of *Nymphalis californica* (Boisduval) in the Sierra Nevada.—On 26 May 1972 while driving east on California Route 140 from Merced into Yosemite National Park, my wife and I observed scattered flights of the California tortoiseshell butterfly, *Nymphalis californica* (Boisduval), along the roadside and occasionally crossing the road. At 1300 hrs., at Red Bud Campground on the Merced River in Sierra National Forest, *Nymphalis californica* was abundant especially on *Aesculus californica*, which was flowering, and along the river itself.

As we continued along the Tioga Road, tortoiseshells became increasingly numerous, flying sometimes in small clouds in front of our car. We observed many specimens dead or crippled in the road, which in places was dotted with their bodies. Steller's jays, *Cyanocitta stelleri*, and robins, *Turdus migratorius*, were observed feeding on these insects, picking them up off the road and flying to nearby trees with them.

Then suddenly, about 1430 hrs., near the overlook at Yosemite Creek Basin (at 8,400 ft. elevation) the butterflies become incredibly abundant. Stopping our car, we walked along the Tioga Road and observed large clouds of butterflies streaming past us on the highway. The temperature in the sun, open air, at this time was 80°F., with light northwesterly winds. As we crossed to the side of the highway and looked down into the basin, we could clearly see large numbers of *Nymphalis californica* welling up from the basin and flying NNW about 2–3 feet above the ground. (The tortoiseshells thus appeared to be flying approximately parallel to and west of the crest of the Sierra.) We estimated that 10–15 butterflies per second were flying past a fixed point. As they crossed the terrain below us, they were easily seen, silhouetted against the light-colored exfoliating granite. Scanning the ground around us, we found many small patches of perhaps two square feet containing up to 14 butterflies, which appeared to be resting. Some patches were shaded, while others were in open sunlight but moist. A scrub jay, *Aphelocoma coerulescens*, was observed here feeding on these insects. Perhaps this bird, which was far from its normal habitat, had come up the creek basin following and feeding upon *Nymphalis*.

During the next few hours we observed smaller numbers of *Nymphalis californica* through Tioga Pass (9,943 ft.) and up into the meadows of Saddlebag Lake Canyon below Mt. Conness. On 27 May during the late morning and early after-

noon we found wings of *Nymphalis californica* lying in melt holes in the snow at altitudes up to 11,480 ft. on the ridge east of Mt. Conness.—RICHARD P. PAPP, *University of California, Berkeley*.

The principal speaker of the evening was DR. HOWELL V. DALY, University of California, Berkeley. His illustrated talk was entitled: "Bees, Twigs and Africa."

Coffee and other refreshments were served during a social hour in the entomology rooms following the meeting.—M. S. WASBAUER, *Secretary*.

THREE HUNDRED AND FORTY-EIGHTH MEETING

The 348th meeting was held Friday, 17 November 1972, in the Morrison Auditorium of the California Academy of Sciences, Golden Gate Park, San Francisco, with President Denning presiding.

Members present (34): F. G. Andrews, C. Armin, P. H. Arnaud, Jr., A. D. Bacon, J. W. Bass, G. S. Benham, Jr., F. L. Blanc, G. Brady, T. Briggs, R. M. Brown, J. A. Chemsak, Karen S. Corwin, T. Delgman, D. G. Denning, Beverly Ehreth, C. P. Farrell, A. R. Gillogly, Lauren Green, J. Guggolz, K. S. Hagen, A. R. Hardy, L. Hawkins, H. B. Leech, R. P. Papp, R. Peterson, C. B. Philip, W. W. Pitcher, E. S. Ross, S. L. Szerlip, R. L. Tassan, T. J. Toren, D. Ubick, M. S. Wasbauer, D. L. Wilson.

Visitors present (30): Barbara Barr, Grace Bass, T. Christensen, J. Collins, Loretta Denning, Margo Ebeling, R. Falls, Kathy Farrell, J. T. Hjelle, H. Implom, D. Moss, N. E. Papp, R. W. Pemberton, D. Phillip, D. Roxon, Suzanne Roxon, W. E. Savary, M. V. Silveira, J. Sorensen, Meta Sorensen, Mary Stark, G. L. Weller, J. F. Wells, Patti Willey, Constance Wilson, R. Wong, Virginia Woo, W. Yee, R. Zarate.

The minutes of the meeting held 20 October 1972 were summarized.

Persons who were proposed for membership in the Society: J. K. Wangberg, R. L. Potts.

The following notes were presented:

In Memoriam—Segundo E. Valastegui B. (15 August 1910–1 July 1972).—Senor Segundo E. Velastegui Barriga, entomologist and commercial collector who was born at and resided in Banos, Ecuador, died from a skull fracture and internal injuries received from a brutal beating. While returning from his work on 28 June 1972, at a point called Ulvilla, near Banos, he was attacked by a young man of about 25 years of age, without apparent reason. Don Segundo was found on the road after the attack by a friend who brought him to a hospital, but it was not possible to save his life.

Senor Velastegui was an excellent collector and he carefully prepared specimens for his correspondents. Visiting extremely interesting areas of the Andes, he collected all types of insects, birds, and orchids. His collections were sold to persons and institutions throughout the world. The Academy and I received nearly 1,000 specimens of Tachinidae in the year prior to his death. His widow informs me that he started working at the age of 10, but I am not certain if this refers to natural history collecting, or perhaps other type of work.

Senor Velastegui is survived by his wife, Etelvina and seven children (Marina, Ysabel, Marta, Danilo, Guillermina, Gloria, and Oliverio). They intend to continue the work of their husband and father and will collect all groups of entomological specimens from "todas partes del Oriente, y del Occidente" and other parts of Ecuador. A drawer of Tachinidae collected by Senor Velastegui is on

display in the entomology rooms.—PAUL H. ARNAUD, JR., *California Academy of Sciences, San Francisco.*

Troglobitic harvestmen observed in lava caves of Washington and Idaho.—Recently much interest in lava cave biology was generated by the discovery of highly modified invertebrates in lava caves of Japan, Idaho and Hawaii. Heretofore, only limestone caves were thought to produce the characteristic modifications of troglobites. Lava caves were assumed to be too small and too brief in geologic time to evolve these modifications. The new discoveries call for a reexamination of cave evolution. Recent explanations (F. Howarth, *Science*, 137:325, 1972) suggest that deep breaks in lava flows provide routes of dispersal from collapsing caves to new caves.

During the 1972 national convention of the National Speleological Society, Robert Lem and I were able to locate several lava troglobites in Washington and Idaho. The Washington caves were located near Mt. St. Helens in the Cascade Range. This area is densely forested and receives much rainfall. Larger lava caves contained a deep interior zone of a peculiar mold or yeast known as "lava tube slime." This moist growth tended to form under lava breakdown and occasionally coated the walls and ceilings with deposits up to an inch thick. Numerous cavernicolous invertebrates lived in association with this food source, including a remarkable laniatorid phalangid. It proved to be the first new world member of family Travuniidae, a group of relicts well known in European limestone caves. White juveniles and pale yellow adults were collected on the slimy habitat.

Specimens of another troglobitic phalangid received from Craters of the Moon National Monument led us to travel to central Idaho. A lava cave was located in a prairie habitat near the town of Shoshone. It had a narrow entrance to a single large room which was particularly rich in life. The cave was unusually warm and had a rock-strewn floor with mold-encrusted walls and ceiling. On entering the room we noted that camel crickets and four families of flies were numerous in the zone of darkness. Abundant evidence of mammal occupation was seen, including three decapitated pigeons and a half-eaten pizza near a large burrow. Under breakdown we found troglobitic beetles (*Glacivicola* of family Leioididae), epigeal beetles, a cavernicolous centipede and large troglobitic phalangids. These and the Craters of the Moon phalangids proved to be in Erebonastriidae, a family not previously known in Idaho.

Many workers are now looking at material from lava caves. I hope to describe the cavernicolous harvestmen in the near future.—THOMAS S. BRIGGS, *Galileo High School, San Francisco.*

The principal speakers of the evening were DRs. W. H. LANGE AND J. ANDERSON, University of California, Davis and Berkeley, respectively. Their illustrated talk was entitled "Entomology Down Under."

Coffee and other refreshments were served during a social hour in the entomology rooms following the meeting.—M. S. WASBAUER, *Secretary.*

THREE HUNDRED AND FORTY-NINTH MEETING

The 349th meeting was held Friday, 15 December 1972, in the Morrison Auditorium of the California Academy of Sciences, Golden Gate Park, San Francisco, with President Denning presiding.

Members present (33): R. P. Allen, P. H. Arnaud, Jr., R. G. Blair, F. L. Blanc, G. Brady, D. Briggs, T. Briggs, D. J. Burdick, J. A. Chemsak, T. Delgman,

D. G. Denning, A. R. Dutton, J. G. Edwards, F. Ennik, J. R. Gabel, M. R. Gardner, A. J. Gilbert, A. R. Gillogly, K. S. Hagen, L. Hawkins, H. B. Leech, R. W. Lem, A. E. Michelbacher, D. W. Moss, Jr., R. L. Peterson, C. B. Philip, R. W. L. Potts, R. E. Stecker, S. L. Szerlip, R. W. Thorp, M. S. Wasbauer, S. C. Williams, R. L. Wong.

Visitors present (21): Fern Blanc, T. Coe, M. J. Croce, J. Denk, Alice Edwards, B. Eya, G. B. Fairchild, Mrs. G. B. Fairchild, Jan and Toni Gabel, D. Gibbs, Marcia Gilbert, Lorraine Kitajima, C. Kitayama, Martha Michelbacher, R. W. Pemberton, W. F. Peregren, Peggie Phillips, W. Raunder, W. E. Savary, M. Silveira, Joyce Thorp, D. Whitman.

The minutes of the meeting held 17 November 1972 were summarized.

The following names were proposed for membership in the Society. Student membership: Joe Denk, Linda Floyd, David W. Moss, Jr., Manual Silveira and Douglas Whitman. Regular membership: Ronald E. Somerby and Donald R. Dilley.

President Denning asked for introductions from the floor. Dr. Philip introduced Dr. and Mrs. G. B. Fairchild. Dr. Fairchild, a medical entomologist with a distinguished career at the Gorgas Memorial Laboratory in Panama is now retired. He and Mrs. Fairchild have just returned from a trip to Australia where they were able to do some good collecting, especially for tabanids. They plan to make their home at Gainesville, Florida.

The following notes were presented:

Prey records for robber flies of the Lake Texoma region, Oklahoma (Diptera: Asilidae).—During June and July 1972 while I was at the University of Oklahoma Biological Station at Lake Texoma, I collected a number of robber flies. Most were collected during the day, but *Diogmites symmachus* Loew was occasionally attracted to lights at night. The largest robber fly taken, *Microstylum morosum* Loew, had bright green eyes while alive. The most colorful robber fly taken was *Mallophora faultrix bromleyi* Curran, a mimic of the common local bumblebee, *Bombus americanorum* (F.). Although all my robber fly collecting was incidental to other studies, my principal interest was in their prey associations. The following eight species were taken with prey by me near the Biological Station, two miles west of Willis, Marshall County, unless otherwise noted:

1. *Diogmites neoternatus* (Bromley), male and female with *Apis mellifera* (Apidae), workers, 5 and 7 July.
2. *Diogmites symmachus* Loew, 3 females with *Calliopsis andreniformis* F. Smith (Andrenidae), female, 30 June; *Tachytes distinctus* F. Smith (Sphecidae), female, 11 July (L. S. B. Koch); and *Sceliphron caementarium* (Drury) (Sphecidae), female, 29 July (L. S. B. Koch).
3. *Efferia nemoralis* Hine, female with *Hemiargus (Echinargus) isola* Reakirt (Lycaenidae), 7 June, 1.2 mi. E. Troy, Oklahoma.
4. *Triorla interrupta* (Macquart), male with *Phyciodes phaon* Edwards (Nymphalidae), 30 June; and female with *Orthemis ferruginea* F. (Libellulidae), 22 July, 5 mi. N. Gordonville, Texas (E. E. Grissell).
5. *Proctacanthus hinei* Bromley, 2 females with *Apis mellifera*, worker, 11 July; and *Bombus fraternus* (F. Smith) (Apidae), worker, 20 July.
6. *Promachus bastardii* (Macquart), male with *Apis mellifera*, worker 9 June; and 2 females with *Alysson melleus* Say (Sphecidae), male, 20 June; and *Halictus ligatus* Say (Halictidae), male, 14 July.

7. *Saropogon dispar* Coquillett, 2 females with *Sceliphron caementarium*, male, 5 June; and *Apis mellifera*, worker, 2 July; 2 males with *Trypoxylon* (*Trypargilum*) *texense* Saussure (Sphecidae), male, 9 June; and *Dialictus* sp. (Halictidae), female, 21 July, Powell, 5 mi. N.W. Willis, Oklahoma.
8. *Stichopogon trifasciatus* (Say), male with (Araneae: Salticidae), 5 June, 1.2 mi. E. Troy, Oklahoma.

The prey of *Diogmites*, *Proctacanthus*, *Promachus* and *Saropogon* consisted entirely of aculeate Hymenoptera. These four robber fly genera contain species considered serious predators of the honey bee. However, *Diogmites symmachus*, commonly referred to as a "Texas bee-killer," was the only species of the group not observed with honey bees as prey. Comparative studies of prey selection by the two sympatric species of *Diogmites* would be of special importance in determining how they divide up their food requisite.

Most of the predators were as large as or larger than their prey, except for the female of *Triorla* which had taken a large dragonfly. The most unusual record was the capture of a jumping spider by the male *Stichopogon*. This is an uncommon habit for the family Asilidae, but has been reported for *S. trifasciatus* (Bromley, 1934, Ann. Entomol. Soc. Amer., 27:74-110).

I thank the following for confirming or correcting my determinations: Dr. J. Wilcox (Asilidae), Dr. R. M. Bohart (Sphecidae), and Mr. C. E. Goodpasture (Lepidoptera).—ROBBIN W. THORP, *University of California, Davis*.

The unexpected loss of one of our student members.—In 1961 Miss Linda May Halverson was first introduced to the subject of entomology by taking a course in General Entomology during the fall semester at San Francisco State College. Through this experience she developed a most absorbing interest in insects. So much so that she began to study insects every possible opportunity and began to make a comprehensive personal collection. By the first of 1972 Miss Halverson had acquired a considerable knowledge of insects and had decided that she wanted to enter a career in entomology, most specifically in the area of medical entomology. On 18 February 1972, she was elected to membership in the Pacific Coast Entomological Society. Meanwhile, she continued her studies in entomology at San Francisco State College, became Curator of the college's insect and arachnid collection, and became a laboratory assistant in the general entomology courses. During the summer of 1972, Miss Halverson secured a position with the Entomology Department of the California Academy of Sciences as a clerical assistant. With the coming of the fall 1972 semester at San Francisco State, Miss Halverson began to prepare for graduation and began preparing her application for graduate study in entomology at the University of California at Berkeley. By this time Miss Halverson had shown a rare gift for the study of insects, and a personal interest not commonly encountered. She also had proven herself as a truly exceptional student. All of her plans and aspirations came to a sudden halt on 25 November 1972 when she died suddenly, as the result of an automobile accident on the San Francisco Bay Bridge. With her death we have lost both an exceptional entomology student and a good friend.—STANLEY C. WILLIAMS, *Division of Biology, San Francisco State University*.

A new technique for study of tarantula burrows.—Study of the burrows of tarantulas (Theraphosidae) has always been hard, sweaty work for it has been necessary to follow the pathways of the burrow by digging in hard soil. Frequently

the "path" is lost when the shovel slides earth into the hole and obscures it. A pliable piece of wire or some similar object thrust into the burrow during digging helps to follow the direction. Digging also obscures any of the probable side chambers dug by the spider. On only one occasion has the author found a side chamber made by the spider. It contained the abandoned excuvia from a previous shedding. Past attempts to "cast" burrows by pouring plaster of Paris into the hole have been unsatisfactory for the hardening time of the plaster varies with the fluidity of the mixture. If the tunnel turns the least bit upward in its meanderings, the plaster sometimes stops flowing and the extent of the burrow is lost.

During a visit to the Southwest Research Station of the American Museum of Natural History near Portal, Arizona, this past summer, the director, Vince Roth, suggested I try injecting foam plastic material into the burrow and then follow the contours when this material hardened. Insta-Foam Products, Inc., Addison, Illinois manufactures an aerosol urethane foam for "insulating, repairing, packaging, sound dampening, sealing, caulking, display building and many other uses." It is packaged in a double tank unit called a "Froth-Pak" which comes with two dispenser nozzles with hoses. The two liquids are mixed by the nozzle after extrusion from the pressurized cans. It hardens into a yellowish foam solid within 60 to 90 seconds. This is sufficient time for the liquids and gas to penetrate all parts of the burrow. The burrow can be carefully excavated by following the pathway of the urethane foam which has completely filled all the crevices and side chambers of the burrow.

My first attempt was successful and four burrows were filled with the foam plastic and subsequently dug out. The soil surrounding the casting was carefully scraped away using a soft stick. It was then washed under running water and carefully scrubbed with a stiff bristle hairbrush. The resulting cast shows all the twists, turns and side chambers of the tunnel and even revealed that two of the burrows had two entrances or an "escape tunnel" connected to the main excavation.

One of the castings contained a discarded excuvia of the former occupant. All burrows "cast" were unoccupied at the time for I had previously washed the spiders out for transplanting experiments. The foam would undoubtedly be fatal to the spider remaining in the burrow. The manufacturer assured me that washing the arachnid out of the burrow prior to "casting" would in no way effect the performance of the foaming plastic.

Because the rainy season in California comes during the winter, there is a minor drawback in "casting" burrows at this time of the year. The Insta-Foam has a critical temperature of 60° to 70° F. Below that temperature it does not harden nor flow out of the cans properly. If the day is sunny and warm, there is no difficulty in using the "twin pak," but on overcast days it may be necessary to use an in-car heater to assure that the two cans in the pak are at the proper temperature. Complete instructions for use are on the side of the package, and experience alone teaches the operator when to shut off the pressure to avoid wasting the foam in "mushroom heads" which form above the burrow entrances as excess plastic extrudes itself from the burrow opening.—J. RUSSEL GABEL, *Division of Biology, California State University at San Francisco.*

The December meeting is traditionally the business meeting of the year and President Denning asked for the reports of the standing committees.

In the treasurer's report, Dr. Arnaud gave the total income for the Society in 1972 as \$13,581.00. This was derived from dues and subscriptions, reprints and miscellaneous page charges, sales of memoirs, advertising income, interest on savings accounts and stock dividends. The total expenditures for the year were \$14,194.00 for the following items: publication costs of the *Pan-Pacific Entomologist*, publication costs of the R. L. Usinger autobiography, reprints, postage and other miscellaneous expenses. The overall decrease in fund balances was thus \$613.00. Dr. Arnaud expressed appreciation to Mr. H. V. Davis who audited the books for the Society again this year. He also thanked Mr. Davis for his help in maintaining the tax-exempt status of the Society with the Internal Revenue Service.

The report of the publication committee was presented by Dr. Chemsak in Dr. Daly's absence and covered the appearance of R. L. Usinger's autobiography in the memoirs series of the Society.

Mr. Leech presented the report of the historical committee for 1972. He addressed himself to the use of the Society's biographical forms which are sent to each new member. Among his observations are the following: of 287 past and present members who have filled out these forms, first letters of the surnames include all letters of the alphabet except Q, X and Y. Data from these forms indicate that the Society as a group is a serious environmental factor. According to the statements on the sizes of private collections, our group is responsible for catching or at least acquiring 3,079,000 insects. The following persons have listed their holdings as 100,000 specimens or more: C. P. Alexander, 100,000 Diptera; D. D. Jensen, 100,000 Homoptera; G. H. Nelson, 100,000 Coleoptera; C. W. O'Brien, 100,000 Coleoptera; J. T. Polhemus, 100,000 Heteroptera; J. Schuh, 100,000 Coleoptera; J. S. Buckett, 150,000 Lepidoptera; J. G. Franclemont, 350,000 Lepidoptera. The following reported 50,000 or more in their collections: F. R. Cole, Diptera; H. R. Dodge, Diptera; C. H. Martin, Diptera; Ian Moore, Coleoptera; J. R. Powers, Coleoptera; R. L. Usinger, Heteroptera; E. L. Sleeper, Coleoptera; P. S. Bartholomew, Coleoptera; S. C. Williams, Scorpionida; J. G. Edwards, Coleoptera. The total figure does not include the hundreds of thousands of specimens collected by such members as R. M. Bohart and E. S. Ross and later donated to various institutions.

Dr. Williams read the report of the membership committee which stated that 26 regular members and 25 student members were elected to Society membership in 1972, a total of 51 new members for the year.

President Denning announced his appointments to the publication committee for 1973 through 1975: Dr. J. G. Edwards and Dr. C. B. Philip.

Dr. R. Stecker, Chairman of the nominating committee, presented the slate of candidates for office in the Society for 1973: President, John A. Chemsak; President-elect, Cornelius B. Philip; Secretary, Michael R. Gardner; Treasurer, Paul H. Arnaud, Jr. There were no nominations from the floor. The candidates were elected to office in the Society for 1973 by unanimous vote.

The principal speaker of the evening was the outgoing President of the Society, DR. D. G. DENNING. His presidential address was entitled, "A resume of the order Trichoptera, with emphasis on western North America."

Coffee and other refreshments were served during a social hour held in the entomology rooms following the meeting.—M. S. WASBAUER, *Secretary*.

INSECT PINS

\$4. / 1000 (10 Pkgs.)

(Plus Postage)

PROMPT DELIVERY

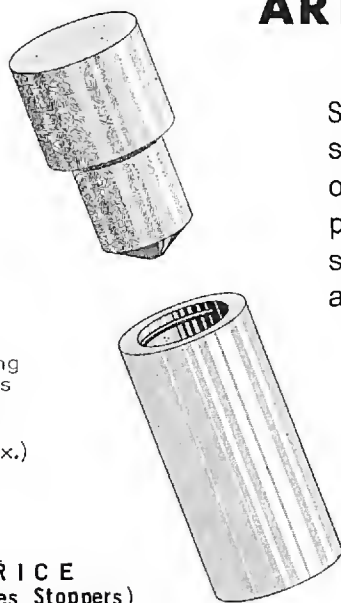
LOWEST PRICES IN AMERICA

CLAIR ARMIN
191 W. Palm Avenue
Reedley,
California 93654

ARTHROPOD MICROVIALS

DESCRIPTION

Semitransparent polyethylene vials with silicone rubber stoppers for use in storage of insect genitalia and other small arthropod parts where association with a pinned specimen or location of small parts in alcohol storage is desirable.



Drawing
4 times
actual
size
(approx.)

ADVANTAGES

- Glycerine will not creep up sides of vial
- Impervious and non-reactive to glycerine, alcohol and other common storage reagents.
- Will not corrode insect pins
- Unbreakable
- Uniform size
- Ideal for class use
- Available at once in two standard sizes

PRICE (Includes Stoppers)

	1000	500
LARGE	\$50.00	\$30.00
SMALL	45.00	28.00

F.O.B. SACRAMENTO

SPECIFICATIONS

LARGE

SMALL

Vial Outside Diameter..... 7/32" (6mm.) 5/32" (4.5mm.)
Vial Length w/Stopper..... 5/8" (16mm.) 9/16" (14mm.)

(Special sizes are available - write for information)

ARTHROPOD SPECIALTIES CO.

P. O. BOX 1973 • SACRAMENTO, CALIFORNIA 95809

COMMERCIAL AND RESEARCH ENTOMOLOGISTS

Obtain more accurate population counts
with a light-weight motor-fan unit
which sucks insects into nets

D-VAC
MOTOR-FAN VACUUM INSECT NETS
BACK-PACKS AND HAND MODELS

-also-

BENEFICIAL INSECTS
INSECTARY GROWN AND FIELD COLLECTED
Trichogramma sp. and Green Lacewings

Write for Brochures

D-VAC CO.
P. O. Box 2095
RIVERSIDE, CALIFORNIA

ENTOMOLOGICAL EXCHANGES AND SALES

Space is available to members and non-members who wish to advertise entomological exchanges, sales, announcements, etc. We can offer an ad in four issues for \$1.50 per line. Ads will be arranged in order of their receipt. Contact the Advertising Manager, W. H. Lange, Department of Entomology, University of California, Davis, California 95616.

Current developments in the sugarbeet industry in the United States are pinpointed in *ADVANCES IN SUGARBEET PRODUCTION: PRINCIPLES AND PRACTICES*, just published by the Iowa State University Press. The control of insects, plant diseases, nematodes and weeds are discussed in addition to other phases of production. Available at \$12.50 from bookstores or from the Iowa State University Press.

FOR SALE. Orders solicited for Pacific Northwest terrestrial and aquatic insects. Queries answered promptly. S. G. Jewett, Jr., Route 1, Box 339, West Linn, Oregon 97068.

FOR SALE. Extensive collection of mayfly reprints. Write R. Brusca, Department of Biology, University of Arizona, Tucson, 85721.

FOR SALE. Over 900 species of butterflies from the Malaysian and Indonesian Jungles, very rare moth (14" wing span), Scorpion, giant sized Indonesian flying lizard, centipedes, stick insects, all types of rhinoceros beetles and rare beetles in the families Scarabaeidae, Lucanidae, Mordellidae, Cerambycidae, etc. Write Sim Yam Seng, 21, Joon Hiang Road, Singapore, 19, Singapore.

THE MOTHS OF AMERICA NORTH OF MEXICO

THE MOTHS OF AMERICA, one of the most significant publications in the history of American entomology, will contain full-color photographs of all 10,000+ species of North American moths. The color photography has been done with excruciating care and attention to detail, and must be seen to be believed.

THE MOTHS OF AMERICA, written by authorities in each group treated, constitutes a thorough review of the North American moths, with descriptions of new genera and species where appropriate.

In addition to the color photographs of adults, illustrations of genitalia or other structures are included where necessary to assure accurate identification. The comprehensive text gives a full taxonomic treatment, including synonymy, plus information on distribution, foodplants, biology, and other aspects of each species.

THE MOTHS OF AMERICA will be published in over 100 parts, over a period of about 20 years. Each part is individually priced, according to its size, number of color plates, and number of copies printed. Three to five parts are expected each year.

Special pre-publication/subscription prices, about 20% less than the regular list prices, apply to subscriptions for the entire work and to orders received prior to the publication of specific parts. (NOTE: The only way to get the parts already published at the reduced prices is to subscribe to the entire series.)

Please start your subscription now, or order the parts you desire, before the cost becomes prohibitive.

ALREADY PUBLISHED:

Fascicle 13, Part 1a, Pyralidae: Scopariinae & Nymphulinae, by Dr. Eugene G. Munroe. 1972. 134 p. \$20.60 (\$16.50 to subscribers).

Fascicle 13, Part 1b, Pyralidae: Odontiinae & Glaphyriinae, by Dr. Eugene G. Munroe. 1972. 116 p. \$20.60 (\$16.50 to subscribers).

Fascicle 20, Part 2a, Bombycoidea: Saturniidae, in part (Citheroniinae and Hemileucinae, in part), by Dr. Douglas C. Ferguson. 1972. 153 p., 11 color plates, 19 figs. \$39.00 (\$32.50 to subscribers).

Fascicle 20, Part 2b, Bombycoidea: Saturniidae, in part (Hemileucinae, in part, and Saturniinae), by Dr. Douglas C. Ferguson. 1972. xxi + 121 p., 11 color plates, 11 figs. \$39.00 (\$32.50 to subscribers).

Fascicle 21, Sphingoidea, by Dr. Ronald W. Hodges. 1971. xii + 158 p., 16 plates (14 in color), 8 halftones, 19 figs. \$24.00 (\$19.60 to subscribers).

IN PREPARATION:

Fascicle 20, Part 1, Bombycoidea (excluding Saturniidae) (i.e., Lasiocampidae, Mimallonidae, Apetelodidae, and Bombycidae), by Dr. J. G. Franclemont.

Fascicle 13, Part 1c, Pyralidae: Evergestiinae, by Dr. Eugene G. Munroe (including 14 color plates for all 3 parts of Fascicle 13. 1).

Fascicle 6, Part 2, Gelechioidea: Oecophoridae, by Dr. Ronald W. Hodges.

Fascicle 22, Part 2, Lymantriidae, by Dr. Douglas C. Ferguson.

Also in preparation: Notodontidae, Cosmopterygidae, Walshidae, and Aegeriidae.

THE MOTHS OF AMERICA NORTH OF MEXICO belongs on the shelf of every serious lepidopterist and in every significant library. Please make sure that your local library subscribes, so that this important reference work will be available to you and your colleagues in the future.

A fully descriptive brochure, with sample color plate and order form, is available on request.

THE MOTHS OF AMERICA NORTH OF MEXICO is distributed exclusively in North America by:



Entomological Reprint Specialists

P.O. Box 77224, Dockweiler Station, Los Angeles, California 90007, U.S.A.

Entomological Reprint Specialists sells any insect book in print. Please write for price lists or quotations.

THE PAN-PACIFIC ENTOMOLOGIST

Information for Contributors

Papers on the systematic and biological phases of entomology are favored, including articles up to *ten* printed pages on insect taxonomy, morphology, behavior, life history, and distribution. Excess pagination must be approved and may be charged to the author. Papers are published in approximately the order that they are received. Immediate publication may be arranged *after* acceptance by paying publication costs. Papers of less than a printed page may be published as space is available, in SCIENTIFIC NOTES.

Manuscripts for publication, proof, and all editorial matters should be addressed to the *Editor*, Robbin W. Thorp, Department of Entomology, University of California, Davis, California 95616.

Typing.—All parts of manuscripts must be typed on bond paper with double-spacing and ample margins. Carbon copies or copies on paper larger than $8\frac{1}{2} \times 11$ inches are not accepted. Do not use all capitals for any purpose. Underscore only where italics are intended in the body of the text, not in headings. Number all pages consecutively and put author's name at the top right-hand corner of each sheet. References to footnotes in text should be numbered consecutively. Footnotes should be typed on a separate sheet.

First page.—The page preceding the text of the manuscript should include (1) the complete title, (2) the order and family in parentheses, (3) the author's name or names, (4) the institution with city and state or the author's home city and state if not affiliated, (5) the shortened title (running headline) not to exceed 38 letters and spaces when combined with the author's last name or names, (6) the complete name and address to which proof is to be sent.

Names and descriptions of organisms.—The first mention of a plant or animal should include the full scientific name with the author of a zoological name *not* abbreviated. Do not abbreviate generic names. Descriptions of taxa should be in telegraphic style.

References.—All citations in text, e.g., Essig (1926) or (Essig, 1958), should be listed alphabetically under LITERATURE CITED in the following format:

Essig, E. O. 1926. A butterfly migration. *Pan-Pac. Entomol.*,
2: 211-212.

1958. *Insects and mites of western North America*. Rev.
ed. The Macmillan Co., New York. 1050 pp.

Abbreviations for titles of journals should follow the list of *Biological Abstracts*, 1966, 47(21): 8585-8601.

Tables.—Tables are expensive and should be kept to a minimum. Each table should be prepared as a line drawing *or* typed on a separate page with heading at top and footnotes below. Number tables with Arabic numerals. Number footnotes consecutively for each table. Use only horizontal rules.

Illustrations.—No extra charge is made for the line drawings or halftones. Submit only photographs on glossy paper and original drawings (no photographs of drawings). Authors *must plan* their illustrations for reduction to the dimensions of the printed page ($4\frac{1}{8} \times 6\frac{3}{4}$ inches). If possible, allowance should be made for the legend to be placed beneath the illustration. Photographs should not be less than the width of the printed page. Drawings should be in India Ink and at least twice as large as the printed illustration. Excessively large illustrations are awkward to handle and may be damaged in transit. Include a metric scale on the drawing or state magnification of the *printed* illustration in the legend. Arrange figures to use space efficiently. Lettering should reduce to no less than 1 mm. *On the back of each illustration* should be stated (1) the title of the paper, (2) the author's complete name and address, and (3) whether he wishes the illustration and/or cut returned to him *at his expense*. Cuts and illustrations not specifically requested will be destroyed.

Figure legends.—Legends should be typewritten double-spaced on separate pages headed EXPLANATION OF FIGURES and placed following LITERATURE CITED. Do not attach legends to illustrations.

Proofs, reprints, and abstract.—Proofs and forms for the abstract and reprint order will be sent to authors. Major changes in proof will be charged to the author. Proof returned to the editor without the abstract will not be published.

Page charges.—All regular papers of one to ten printed pages are charged at the rate of \$18.00 per page. This is in addition to the charge for reprints and does not include the possible charges for extra pagination or the costs for immediate publication. Private investigators or authors without institutional or grant funds to cover this charge may apply to the Society for a grant to cover the page charges. A mark in the appropriate box (society grant desired) on the reprint order form will suffice as an application.

All articles are accepted for publication *only* on the basis of scientific merit and without regard to the financial support of the author.

**PUBLICATIONS
OF THE
PACIFIC COAST ENTOMOLOGICAL SOCIETY**

PROCEEDINGS OF THE PACIFIC COAST ENTOMOLOGICAL SOCIETY.

Vol. 1 (16 numbers, 179 pages) and Vol. 2 (numbers 1-9, 131 pages). 1901-1930. Price \$2.50 per volume.

PAN-PACIFIC ENTOMOLOGIST.

Vol. 1 (1924) to present. Price \$10.00 per volume of 4 numbers, or \$2.50 per single issue.

MEMOIR SERIES.

Volume 1. *The Sucking Lice* by G. F. Ferris. A 320-page book which summarizes the knowledge of the Anoplura of the world. Published October 1951. Price \$6.00. (Plus 35¢ postage.)*

Volume 2. *The Spider Mite Family Tetranychidae* by A. Earl Pritchard and Edward W. Baker. This worldwide treatment deals with the systematics, identification, and economics of the "Red Spiders" and includes descriptions of 33 new species. 472 pages. Published July 1955. Price \$10.00. (Plus 50¢ postage.)*

Volume 3. *Revisionary Studies in the Nearctic Decticinae* by David C. Rentz and James D. Birchim. This 173-page revision of Nearctic shield-back katydids includes descriptions of one new genus and 13 new species and subspecies. Published July 1968. Price \$4.00. (Plus 25¢ postage.)*

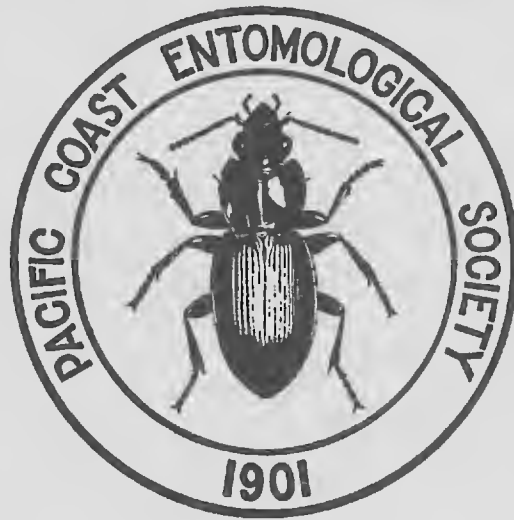
Volume 4. *Autobiography of an Entomologist* by Robert L. Usinger. A 343 page book relating the life story of one of the outstanding entomologists of our time. Published August 1972. Price \$15.00. (Plus 40¢ postage.)*

* (Add 5% sales tax on all California orders. Members of the Society will receive a 20% discount.)

Send orders to:

Pacific Coast Entomological Society
c/o California Academy of Sciences
Golden Gate Park
San Francisco, California 94118

THE PAN-PACIFIC ENTOMOLOGIST



SMITH—The sawfly tribe Lycaotini in South America (Hymenoptera: Tenthredinidae)	93
FRANKIE—Feeding habits and seasonal history of <i>Ernobius conicola</i> in cones of Monterey cypress with notes on cohabiting insects (Coleoptera: Anobiidae)	102
BENTZIEN—Biology of the spider <i>Diguetia imperiosa</i> (Araneida: Diguetidae)	110
TORGERSEN—A new species of <i>Spinolochus</i> from North America (Hymenoptera: Ichneumonidae)	124
HARDY—A new species of <i>Phobetus</i> (Coleoptera: Scarabaeidae)	127
DENNING—New species of Trichoptera	132
ALCOCK AND RYAN—The behavior of <i>Microbembex nigrifrons</i> (Hymenoptera: Sphecidae)	144
GOODPASTURE—A new subspecies of <i>Plebejus acmon</i> (Lepidoptera: Lycaenidae)	149
ALLEN—New Ephemerellidae from Madagascar and Afghanistan (Ephemeroptera)	160
SOLEGLAD—A redescription of the scorpion <i>Vejovis flavus</i> (Scorpionida: Vejovidae)	165
DAILEY AND SPRENGER—Unisexual generation of <i>Andricus atrimentus</i> (Hymenoptera: Cynipidae)	171
DAILEY AND CAMPBELL—A new species of <i>Diplolepis</i> from California (Hymenoptera: Cynipidae)	174
ARNAUD AND WALE—Thomas Wrentmore Cook (1884–1962)	177
SCIENTIFIC NOTES	126, 182
BOOK REVIEWS	101, 123, 143, 176, 184
RECENT LITERATURE	148, 173
EDITORIAL NOTICE	184

SAN FRANCISCO, CALIFORNIA • 1973

Published by the PACIFIC COAST ENTOMOLOGICAL SOCIETY
in cooperation with THE CALIFORNIA ACADEMY OF SCIENCES

THE PAN-PACIFIC ENTOMOLOGIST

EDITORIAL BOARD

R. W. THORP, *Editor*
E. G. LINSLEY R. O. SCHUSTER, *Asst. Editor* E. S. ROSS
P. D. HURD, Jr. D. L. BRIGGS, *Editorial Assistant* H. B. LEECH
P. H. ARNAUD, Jr. *Treasurer* W. H. LANGE, Jr. *Advertising*

Published quarterly in January, April, July, and October with Society Proceedings appearing in the January number. All communications regarding nonreceipt of numbers, requests for sample copies, and financial communications should be addressed to the Treasurer, Dr. Paul H. Arnaud, Jr., California Academy of Sciences, Golden Gate Park, San Francisco, California 94118.

Application for membership in the Society and changes of address should be addressed to the Secretary, Mr. Michael R. Gardner, Laboratory Services, California Department of Agriculture, 1220 N. St., Sacramento, California 95814.

The annual dues, paid in advance, are \$7.50 for regular members of the Society, \$5.00 for student members, or \$10.00 for subscriptions only. Single copies are \$2.50 each or \$10.00 a volume. Make checks payable to *Pan-Pacific Entomologist*.

The Pacific Coast Entomological Society

OFFICERS FOR 1973

J. A. CHEMSAK, *President* PAUL H. ARNAUD, JR., *Treasurer*
C. B. PHILIP, *President-elect* MICHAEL R. GARDNER, *Secretary*

STATEMENT OF OWNERSHIP

Title of Publication: The Pan-Pacific Entomologist.

Frequency of Issue: Quarterly (January, April, July, October).

Location of Office of Publication, Business Office of Publisher, Publisher and Owner: Pacific Coast Entomological Society, California Academy of Sciences, Golden Gate Park, San Francisco, California 94118.

Editor: Dr. Robbin W. Thorp, Department of Entomology, University of California, Davis, California 95616.

Managing Editor and Known Bondholders or other Security Holders: None.

This issue mailed 11 July 1973

Second Class Postage Paid at Lawrence, Kansas, U.S.A. 66044.

ALLEN PRESS, INC.

PRINTED
IN
U.S.A.

LAWRENCE, KANSAS

The Pan-Pacific Entomologist

VOL. 49

APRIL 1973

No. 2

The Sawfly Tribe Lycaotini in South America

(Hymenoptera: Tenthredinidae)

DAVID R. SMITH¹

Systematic Entomology Laboratory, Agricultural Research Service, USDA

The tribe Lycaotini is represented by two genera in South America and is found in Ecuador, Bolivia, southern Brazil, and Chile. These genera are related to, but distinct from, *Lycaota* Konow and *Blennogeneris* MacGillivray, the two lycaotine genera found in western North America. This distribution represents another example of the occurrence of closely related forms in North and South America. Other bipolar taxa of the Tenthredinidae are *Pristiphora* Latreille in North America and southern Brazil, *Periclista* Konow in North America and Chile and southern Argentina, and the Fenusini with the genera *Profenusa* MacGillivray and *Bidigitus* Smith in North America closely related to *Notofenusa* Benson and *Brasinusa* Malaise in Chile, Argentina, and southern Brazil. The northernmost species of Lycaotini in South America is *Synaptoneura vopida* n. sp. in Ecuador. No other representatives of the tribe are found to the north until *Lycaota bouquetensis* Smith is encountered in southern California.

Benson (1966) gave a key to eight world genera of Lycaotini. He included only the genus *Trichotaxonus* Rohwer (= *Kuschelia* Malaise) from South America, neglecting to mention *Synaptoneura* Konow. Smith (1969) defined the tribe and treated the Nearctic species. This tribe is in the subfamily Blennocampinae and is distinguished by the venation of the forewing as follows: Veins M and Rs + M meet Sc + R at the same point; veins M and 1m-cu parallel; and vein 2A and 3A complete, fused to 1A for short distance at center or slightly separated from 1A but connected to 1A by a very short crossvein. Vein 2A and 3A is sometimes separated from 1A in the species *Trichotaxonus coquimbensis* (Spinola) but this is a variable character and this vein is usually fused to 1A. Specimens which have vein 2A and 3A separated may be

¹ Mail address: c/o U. S. National Museum, Washington, D. C. 20560.

confused with the Allantinae, but the Allantinae have a long, oblique anal crossvein and vein 2A and 3A is widely separated from 1A.

Another genus of Blennocampinae, *Metaneura* Malaise, has a small basal anal cell in the forewing formed by the basal stub of vein 2A and 3A curving up and meeting 1A. This genus, however, is more closely related to other genera of Blennocampinae in which the basal stub of 2A and 3A is curved up but not meeting 1A; therefore, it is not included in the Lycaotini.

The kind cooperation of the following has made this review of South American Lycaotini possible: Dr. J. Oehlke, Institut für Pflanzenschutzforschung, Eberswalde, Germany; Dr. Per Inge Persson, Naturhistoriska Riksmuseet, Stockholm, Sweden; Dr. B. Pisarski, Polska Akademia Nauk, Instytut Zoologiczny, Warsaw, Poland; Dr. M. Zunino, Museo ed Istituto di Zoologia Sistemica, Università di Torino, Torino, Italy; and Dr. Paul H. Arnaud, Jr., Department of Entomology, California Academy of Sciences, San Francisco.

KEY TO THE GENERA OF LYCAOTINI

Tarsal claws bifid, with basal lobe; malar space distinct *Synaptoneura* Konow
 Tarsal claws trifid, without basal lobe; malar space linear
 *Trichotaxonus* Rohwer

SYNAPTONEURA KONOW

Synaptoneura Konow, 1908, p. 160. Type-species: *Synaptoneura boliviensis* Konow. Monotypic.

DESCRIPTION.—Antenna long, slender, first and second segments each longer than broad, third segment slightly longer than fourth segment, segments beyond third gradually decreasing in length (Fig. 7). Clypeus with shallow central emargination; malar space distinct, nearly as wide as diameter of front ocellus; no genal carina; eyes small, converging below but farther apart below than length of an eye; postocellar area broader than long. No prepectus; distance between cenchri equal to breadth of a cenchrus. Tarsal claw bifid, inner tooth slightly shorter than outer tooth and teeth closely appressed; basal lobe distinct, acute (Fig. 5); hindbasitarsus shorter than following segments combined. Forewing with vein 2A and 3A complete, fused with 1A at center. Hindwing with cell M present; anal cell sessile; apex of radial cell close to margin of wing, with short spurious vein. Male of *S. vopida* with peripheral vein in hindwing. Wings as in Fig. 1.

→

FIG. 1, forewing and hindwing of *Trichotaxonus coquimbensis*, ♀. FIG. 2, anal cell of forewing of *T. coquimbensis*, ♀, variation. FIG. 3, hindwing of *T. coquimbensis*, ♂. FIG. 4, tarsal claw of *T. coquimbensis*. FIG. 5, tarsal claw of *Synaptoneura vopida*. FIG. 6, antenna of *T. coquimbensis*. FIG. 7, antenna of *S. vopida*.

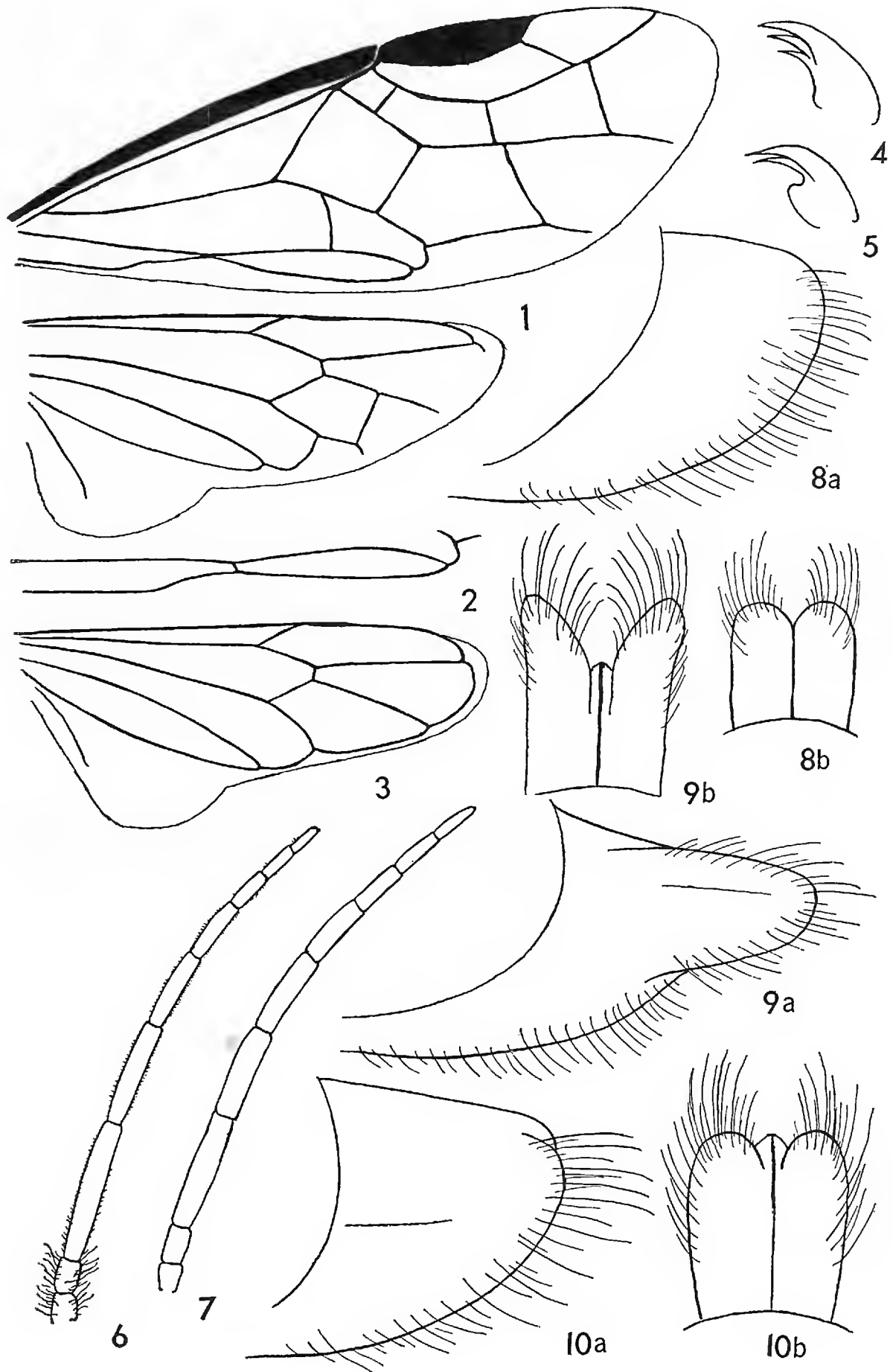


FIG. 8, female sheath of *T. coquimbensis*, a. lateral and b. dorsal. FIG. 9, female sheath of *S. boliviensis*, a. lateral and b. dorsal. FIG. 10, female sheath of *S. vopida*, a. lateral and b. dorsal.

DISCUSSION.—In the only known specimen of *S. boliviensis*, a female, the antennae are missing; therefore, the above characters given for the antenna as well as for the male are based on *S. vopida*.

This genus is distinguished by the broad malar space and the bifid tarsal claws with a basal lobe.

KEY TO SPECIES OF SYNAPTONEURA

Abdomen black; hindfemur and hindtibia orange; female sheath with slender, protruding scopa (Fig. 9a, 9b) *boliviensis* Konow
 Abdomen, except for apical two or three segments, orange; hindlegs black; female sheath with short, blunt scopa (Fig. 10a, 10b) *vopida* Smith, n. sp.

SYNAPTONEURA BOLIVIENSIS Konow

Synaptoneura boliviensis Konow, 1908, p. 160. ♀.

FEMALE.—Length, 7.2 mm. Antenna and head black (flagellum missing). Thorax black. Legs black with each femur except for extreme base, outer surface of foretibia, and hindtibia except for extreme apex, orange. Abdomen black with very narrow white band on posterior margin of each segment. Wings uniformly lightly infuscated; veins and stigma black. Sheath with slender protruding scopa at apex, from above widened toward apex, in lateral view long, straight above and rounded below (Fig. 9a, 9b). Serrulae of lancet far apart, rounded, those near center symmetrical, those at apex asymmetrical.

MALE.—Unknown.

TYPE.—Female, at the Institut für Pflanzenschutzforschung, Eberswalde, Germany, labeled "Mapiri, Bolivia," "Coll. Konow," "typus" [red label], and the handwritten name label "*Synaptoneura boliviensis* Knw., Bolivia."

DISTRIBUTION.—Known only from the type locality.

DISCUSSION.—This species is distinguished from *S. vopida* by the black abdomen, partly orange legs, and the structure of the female sheath, as illustrated.

Synaptoneura vopida Smith, new species

FEMALE.—Average length, 7.0 mm. Antenna and head black. Thorax black, only upper portion of metapleuron with orange spot. Legs black, apical half of forefemur, extreme base of foretibia, and apex of midfemur orange. Abdomen orange with basal plates, apical two or three segments, and mesal stripe on venter black; sternites except for apical two or three segments sometimes all orange. Wings uniformly, lightly infuscated; veins and stigma black. Antenna long, slender, about two and one-half times width of head. Sheath with short, blunt scopa, from above broad and slightly widened toward apex, in lateral view, straight above and rounded below (Fig. 10a, 10b). Lancet with serrulae shallow, rounded and far apart (Fig. 12).

MALE.—Average length, 6.5 mm. Color and structure similar to that of female. Hindwing with peripheral vein. Harpe and parapenis as in Fig. 15; penis valve rectangular, with lateral spine (Fig. 16).

Holotype female, LAGO ZURUCUCHU, 11 MI. W. OF CUENCA, ECUADOR, 16 February 1965, E. I. Schlinger and E. S. Ross. At the California Academy of Sciences, San Francisco.

PARATYPES.—Same data as for holotype (5♀, 18♂); Ecuador, 45 mi. S. Alausi, Chimborazo, 3,000 m, 20 February 1955, E. I. Schlinger and E. S. Ross (1♀); Ecuador, 40 mi. S. Alausi, Chimborazo, 20 February 1955, E. I. Schlinger and E. S. Ross (1♀).

DISCUSSION.—This species is separated from *S. boliviensis* by the mostly orange abdomen, black hindlegs, and lack of a protruding scopa of the sheath. The species name is an arbitrary combination of letters and is to be treated as a noun.

TRICHOTAXONUS Rohwer

Trichotaxonus Rohwer, 1910, p. 30. Type-species: *Trichotaxonus reedi* Rohwer. Orig. desig.
Kuschelia Malaise, 1949, p. 21. Type-species: *Netrocerus solox* Enderlein. Orig. desig. New synonymy.

DESCRIPTION.—Antenna with first and second segments each longer than broad, third segment longer than fourth segment, segments beyond third gradually decreasing in length, the apical four segments not reduced (Fig. 6). Clypeus with small circular emargination; malar space linear; no genal carina; each mandible bidentate; eyes small, distance between eyes below longer than eye length; post-ocellar area as long as broad. No prepectus; distance between cenchri equal to breadth of a cenchrus. Each tarsal claw trifold, without basal lobe (Fig. 4); hindbasitarsus shorter than following tarsal segments combined. Forewing with vein 2A and 3A complete, either fused to 1A at center forming subequal basal and distal anal cells or connected to 1A by very short anal crossvein at this point. Hindwing with cell M present; anal cell with very short petiole or sessile; radial cell ends slightly before apex of wing and with short spurious vein. Male of *coquimbensis* with peripheral vein in hindwing. Wings as in Figs. 1-3.

DISCUSSION.—The trifold tarsal claws will separate *Trichotaxonus* from *Synaptoneura*. For avoidance of possible confusion of this genus with *Antholcus* Konow (Allantinae), see discussion under *T. coquimbensis*.

KEY TO SPECIES OF TRICHOTAXONUS

- Long flexuous hairs on thorax, head, and legs; thorax black, abdomen, except for apical segments and basal plates, orange; clypeus with slight central emargination; Chile *coquimbensis* (Spinola)
 Long hairs absent, vesture of short pubescence; thorax mostly red, abdomen black; clypeus truncate; Brazil *luteithorax* (Enderlein)

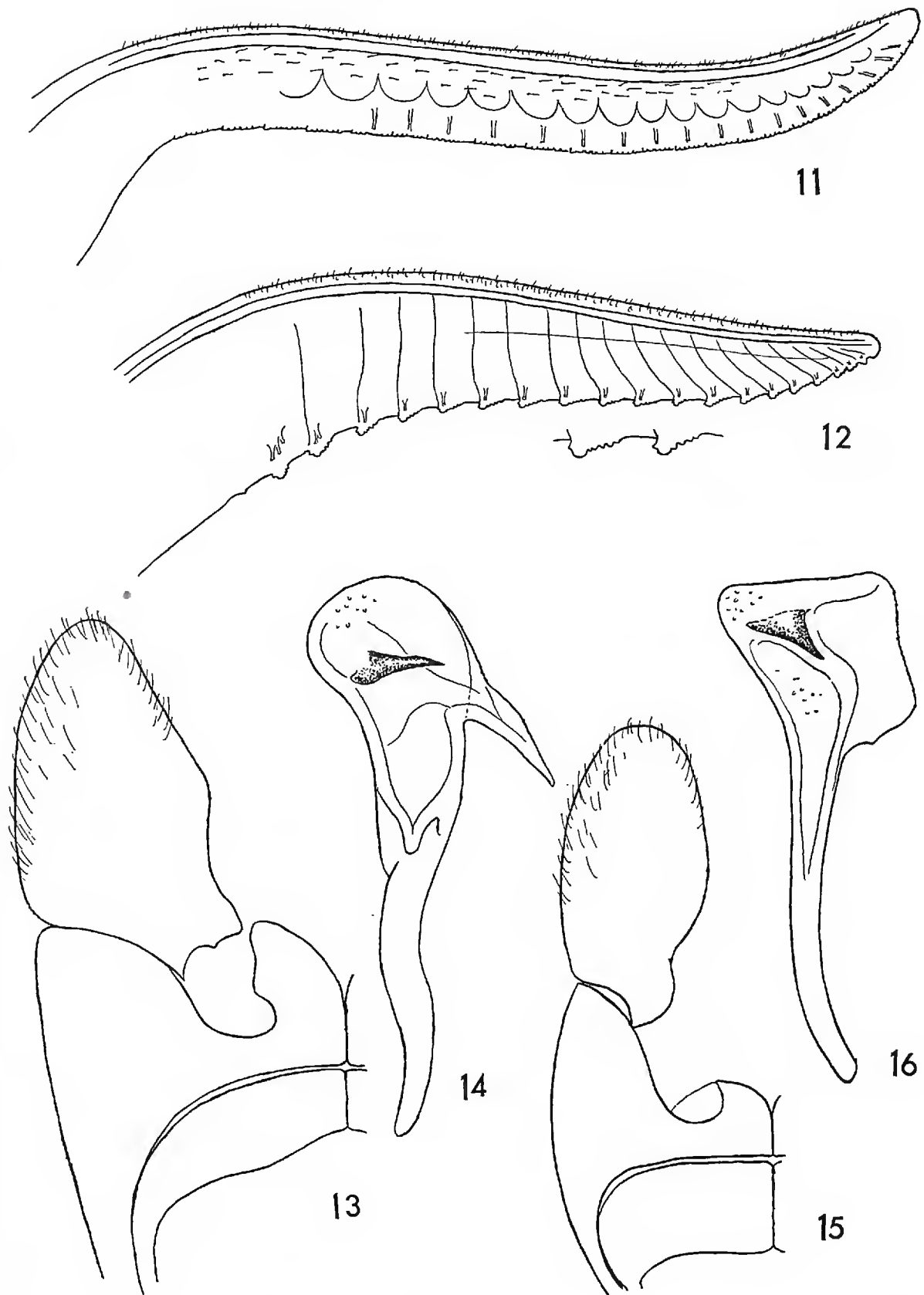


FIG. 11, female lancet of *Trichotaxonus coquimbensis*. FIG. 12, female lancet of *Synaptoneura vopida*. FIG. 13, male harpe and parapenis of *T. coquimbensis*. FIG. 14, penis valve of *T. coquimbensis*. FIG. 15, male harpe and parapenis of *S. vopida*. FIG. 16, penis valve of *S. vopida*.

TRICHOTAXONUS COQUIMBENSIS (Spinola), new combination

Tenthredo coquimbensis Spinola, 1851, p. 556.

Blennocampa chilensis Brèthes, 1910, p. 145. ♂. New synonymy.

Zarca chilensis: Brèthes, 1919, p. 51 (♀).

Trichotaxonus reedi Rohwer, 1910, p. 30. "♀" = ♂ (correction of sex on insert between pages 30 and 31). New synonymy.

Netrocerus solox Enderlein, 1920, p. 372. ♀ ♂. New synonymy.

Kuschelia solox: Malaise, 1949, p. 22; Benson, 1966, p. 75.

FEMALE.—Length, 9.0 mm. Antenna and head black. Thorax black. Legs black with apical half of forefemur, outer surface of foretibia, outer surface of midtibia whitish, and hindfemur entirely orange. Abdomen orange with basal plates and apical two segments and sheath black. Wings uniformly darkly infuscated; veins and stigma black. Head, thorax, and legs covered with long flexuous hairs, longer than length of first antennal segment. Clypeus with shallow central emargination; postocellar area about as long as broad. Vein 2A and 3A of forewing either fused to 1A at center or separated from 1A by very short anal crossvein. Sheath from above uniformly broad, in lateral view straight above, rounded below (Fig. 8a, 8b). Serrulae of lance flat, with no anterior and 10 to 13 posterior subbasal teeth (Fig. 11).

MALE.—Average length, 8.2 mm. Color and structure as for that of female. Harpe and parapenis as in Fig. 13; penis valve with lateral spine (Fig. 14).

TYPES.—The type of *T. coquimbensis* Spinola is in the Museo ed Instituto di Zoologia Sistemática, Università di Torino, Italy. Three specimens are under the name *coquimbensis*, one of which is a female labeled "Typus" and "*Kuschelia coquimbensis* Spinola, det. R. Malaise, 1955." The other specimens are a male and female which lack labels except for "♀" and "*Antholcus varinervis* Spinola, det. R. Malaise, 1955" on the female. The specimen labeled "Typus" is the species treated here and it agrees well with Spinola's description. The other two specimens are *Antholcus varinervis* (Spinola) as they agree with Spinola's description and follow the traditional usage of the name. Specimens which may be the types of that species have not been located. Spinola did not state how many specimens he examined; however, in order to fix the identity of *T. coquimbensis*, I am hereby designating the specimen labeled "Typus" as lectotype.

The type of *Blennocampa chilensis* Brèthes may be at the Museo Argentino de Ciencias Naturales Bernardino Rivadavia, Buenos Aires. I have not been able to examine the specimen, but it is clear from Brèthes' descriptions of 1910 and 1919 that this is the same as *T. coquimbensis*.

Rohwer's types of *T. reedi*, four males, are in the U. S. National Museum, type no. 13076, and each is labeled "Chile, E. C. Reed." Three specimens are the species treated here, and I am hereby desig-

nating one of them as lectotype. The other specimen is *Antholcus varinervis* (Spinola).

The type of *Netrocerus solox* Enderlein is in the Polska Akademia Nauk, Instytut Zoologiczny, Warsaw, a female labeled "Chile," "Type" [red label], and a handwritten name label "Netrocerus solox Enderlein, ♀, Dr. Enderlein det. 1918."

DISTRIBUTION.—Chile. My confirmed records: Cubillo, Cord. Curico, 24–26 January 1961; El Pangué, Coquimbo, 1,500 m., 3–5 November 1961, 4 November 1961; El Manzanito, 24 October 1948; Estero Cabrera, Cord. Curico, 9 February 1961; El Coigo, Cord. Curico, February 1961; Acon. Zapallar, 15 December 1950.

DISCUSSION.—The black thorax, orange abdomen, and long hairs of the head, thorax, and legs will distinguish this species from *T. luteithorax*. It is more likely to be confused with *Antholcus varinervis* (Spinola), a species in the Allantinae from Chile, because of the similarity of coloration and variation of the anal veins in *T. coquimbensis*. *Antholcus varinervis* has the abdomen entirely orange, each femur and tibia mostly orange, lacks long hairs, has a long oblique anal crossvein in the forewing, and has the anal cell of the hindwing petiolate. In *T. coquimbensis*, vein 2A and 3A may be separated from 1A but is connected to 1A by a very short crossvein.

TRICHOTAXONUS LUTEITHORAX (Enderlein), new combination

Lycaota luteithorax Enderlein, 1920, p. 370. ♀.

FEMALE.—Length, 8.3 mm. Antenna and head black. Thorax orange with mesoscutellum and metanotum black. Legs and abdomen black. Wings uniformly, black infuscated; veins and stigma black. Pubescence on head and thorax much shorter than length of first antennal segment. Clypeus truncate; labrum short and broad, truncate; postocellar area slightly broader than long. Sheath thin from above, in lateral view, straight above, rounded below. Vein 2A and 3A of forewing nearly fused at center with 1A, very short crossvein present (similar to Fig. 2).

MALE.—Unknown.

TYPE.—At the Polska Akademia Nauk, Instytut Zoologiczny, Warsaw, Poland, a female labeled "S. Catarina, Luderwaldt," "Type," [red label], and a handwritten determination label "Lycaota luteithorax Enderlein, ♀ type, Dr. Enderlein det. 1918."

DISTRIBUTION.—Known only from the type locality in Brazil.

DISCUSSION.—A distinctive species, *T. luteithorax* is separated from *T. coquimbensis* by the mostly orange thorax, black abdomen, and lack of long, flexuous hairs on the head, thorax, and legs.

LITERATURE CITED

- BENSON, R. B. 1966. A new genus of the Lycaotini (Blennocampinae) in Turkey (Hymenoptera: Tenthredinidae). Proc. Roy. Entomol. Soc. London Ser. (B) Taxon., 35: 75-77.
- BRÈTHES, J. 1910. Quelques Hyménoptères du Chili. Rev. Chilena Hist. Natur., 14: 141-146.
1919. Tenthredines nouveaux du Chili. Rev. Chilena Hist. Natur., 23: 49-52.
- ENDERLEIN, G. 1920. Symphytologica II. Zur Kenntnis der Tenthredininen. Sitz. Gesell. Naturf. Freunde Berlin 9: 347-374 (Nov. 1919 issue, published Jan. 1920).
- KONOW, F. 1908. Neue mittel- und südamerikanische Tenthrediniden (Hym.). Z. Syst. Hymenopt. Dipt., 8: 144-163.
- MALAISE, R. 1949. The genera *Waldheimia*, *Probleta*, and other Neotropical Tenthredinoidea (Hym.). Ark. Zool., 42A: 1-61.
- ROHWER, S. A. 1910. A new genus of sawflies from Chile (Hymenoptera: Tenthredinidae). Proc. Entomol. Soc. Wash., 12: 30.
- SMITH, D. R. 1969. Nearctic sawflies I. Blennocampinae: Adults and larvae (Hymenoptera: Tenthredinidae). U. S. Dep. Agr. Tech. Bull. 1397, 179 pp.
- SPINOLA, M. 1851. Hymenoptera. In Gay, C., Historia física y política de Chile, Zoología, v. 6, p. 153-572.

BOOK REVIEW

MONOGRAFIA DA TRIBO IBIDIONINI (COLEOPTERA, CERAMBYCINAE). By Ubirajara R. Martins. Partes I-VI. Arquivos de Zoologia, 16 (1-6, + estampas 1-30). Parte I (30.XI.1967), pp. 1-320, figs. 1-180. Parte II (15.VIII.1968), pp. 321-630, figs. 181-347. Parte III (30.IX.1969), pp. 631-878, figs. 348-454. Parte IV (5.III.1970), pp. 879-1150, figs. 455-586 (pp. 878 and 1150 are blank). Parte V (5.VIII.1970), pp. 1151-1341, figs. 587-683. Estampas 1-30 (30.IX.1970), 120 figs. in color. Parte VI (1971), pp. 1343-1508, figs. 684-710. From the Museu de Zoologia da Universidade de São Paulo, Avenida Nazaré 481, Caixa Postal 7172, São Paulo, S. P. Brasil. Price not stated.

The book-sized parts of this revisional study indicate the amazing extent of this neotropical tribe (Old World genera, earlier placed in it, are now excluded), and the high proportion of new genera show the need there has been for restudy. North American species are of course included. The work is replete with keys for identification, redescriptions, figures of whole beetles and dissections of mouthparts, genitalia, etc. There are new data on the habits of adults and the host plants of larvae; the 120 figures in color are uniformly fine; the work contains a broad spectrum of data, good mining ground for other than coleopterists, and Dr. Martins should receive the thanks of all. A supplementary paper describing 17 new species and designating lectotypes for Lacordaires species also appeared in 1971 (Arq. Zool. Estado São Paulo, 21 (3): 121-178, 25 figs.).—HUGH B. LEECH, *California Academy of Sciences, San Francisco, 94118.*

Feeding Habits and Seasonal History of *Ernobius conicola* in Cones of Monterey Cypress with Notes on Cohabiting Insects

(Coleoptera: Anobiidae)

GORDON W. FRANKIE

Department of Entomology, Texas A & M University, College Station, 77843

Most species in the family Anobiidae are poorly understood, biologically and ecologically (White 1962, pers. comm.). Members of this beetle family are almost always characterized as infesting dying or dead plant material (Arnett 1968, Baker 1972, Borror and DeLong 1971, Hatch 1961). However, some species, e.g. in the genus *Ernobius*, are known to occur in both living and dead plant tissue (Arnett 1968, Fisher 1919, Hatch 1961, Keen 1958, Ruckes 1957).

Ernobius conicola Fisher has been reported infesting green and dry cones of Monterey cypress, *Cupressus macrocarpa* Hartwig (Fisher 1919). Essig (1926) observed that the insect also infests dead branches of the same host. Keen (1958) stated, "it feeds for the most part on the blighted, dead, dry cones killed by other insects." In 1965, I found this insect in abundance in developing green cones of this cypress.

Since reports on the habits of this beetle are incomplete and somewhat inconsistent, a study extending over several years was undertaken to learn more about the relationships of *Ernobius* to developing, mature and senescent cones of Monterey cypress in primarily native stands of the host plant. Information was also collected on seasonal history, cohabiting insects, and feeding habits of *Ernobius* in those respective cone age groups.

DISTRIBUTION OF HOST PLANT AND BEETLE.—With the exception of two uncertain host records¹, *E. conicola* is known only from Monterey cypress. The cypress is planted extensively along coastal California and sparsely in the interior part of the state (Wagener 1939). It occurs in the native state in two, small, coastal endemic stands at Point Lobos and Cypress Point in Monterey County (Wolf and Wagener 1948).

Based on personal collections and museum records, it appears that the beetle has a limited distribution within the range of the cypress. In the two native groves, *E. conicola* is commonly found in cypress cones. In all adventive localities, from San Luis Obispo County to

¹ One collection was made in Monterey County, California from *Myrica californica* Cham. & Schlecht, while the other specimen was taken from *Pinus muricata* D. Don in the same county. However, it is not clear from the attached host labels whether the beetles were collected on the plants or reared from them.

Contra Costa County, *Ernobius* has been collected mostly from coastal situations where it occurs only occasionally in the cones.

PROCEDURE.—Samples of cones, collected from Cypress Point and Pescadero Point in Monterey County, were dissected and examined to obtain information on the relationship of cone age to potential infestation by *Ernobius*. On three occasions, the samples, consisting of 200 cones from each of the available age groups, were gathered randomly from eight trees which showed some evidence of a current infestation. While dissecting cones, data were simultaneously gathered on seasonal history development and the feeding behavior of the insect within each of five recognized cone age classes.

Female strobili or cones of species in the genus *Cupressus* require two years to mature. For the purposes of this investigation, the cones were classified by age according to the following scheme:

- Cone Age: 1 – Unpollinated, soft, succulent cones in first year of development. Growth period generally begins in January and extends to December of same year.
- 1.5 – Cones entering second year of development. After pollination by wind (February–March), cones become less succulent and noticeably harder. Period begins in January and ends in early August of second year.
- 2 – Second year, mature cones which, through aging, have become woody. Period extends from mid August of second year to about March of third year.
- 3 – Third year cones² beginning to deteriorate from natural aging processes and repeated insect infestations. About 85% of scales are dry; cone cores remain resinous. Period extends from April to December of third year.
- >3 – Dry non-resinous cones which are older than three years of age.

The phenology of the developing cones (in particular, the 1 year class) did not always proceed as described above. In some years (e.g. 1972) the appearance as well as growth of the new first year cones was delayed as much as four months. Generally, such a paucity in development was common to all the cypress trees in a given area.

SEASONAL HISTORY DEVELOPMENT.—Larvae of *E. conicola* were found throughout the year in the cypress cones (Fig. 1). Generally all instars were well represented in each month with the exception of winter when mid to late instar larvae predominated. Pupae were present from early March to the middle of September (Fig. 2). The first adults flew in mid March; adult emergence continued until the first part of October

² Third year cones, having little to no deterioration, were not sampled due to the difficulty of locating adequate numbers from the sample trees.

(Fig. 3). Keen (1958) mentioned that, "the principal adult emergence occurs from late May through June and July to the first of August." Based on findings from the cone dissections and adult emergence records, the egg-laying period is probably continuous from late March to mid October.

RELATIONSHIP OF CONE AGE TO INFESTATION.—Due to the incompleteness of the three samples, each of which was collected in a different year, the results presented in Table 1 allowed for only limited insight into the relationship of cone age to the level of infestation by *Ernobius*. However, the nearly equal degree of infestation (about 10%) of 2 year cones observed on each sample date provided support for the following generalizations.

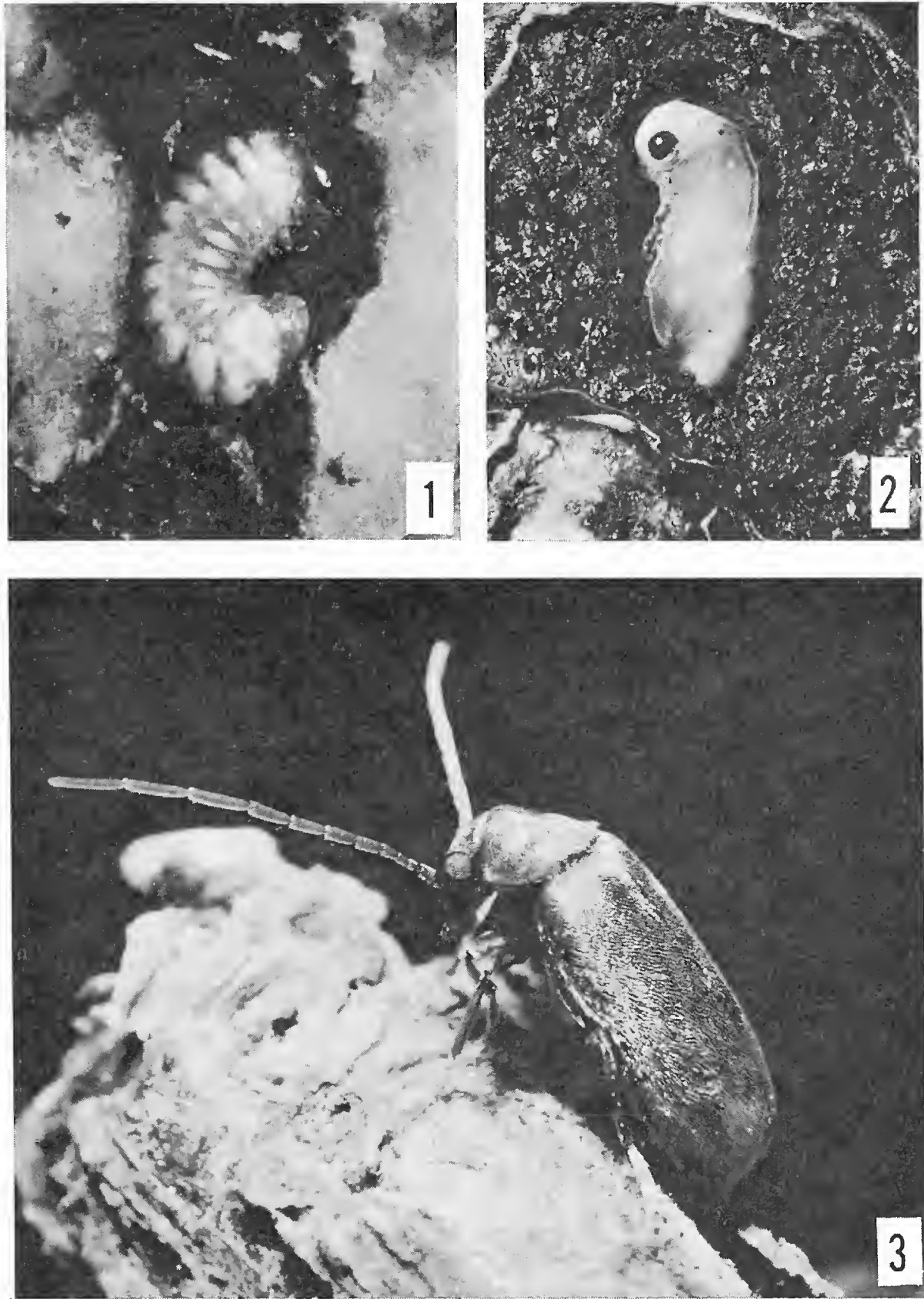
Cones in the 2 and 3 year age groups sustained the highest levels of infestation, while the 1 and >3 year groups experienced the lowest number of infestations. The relative attractiveness of the 1.5 year group was difficult to evaluate because of the transitional nature of this age class.

The relatively low number of infested 1.5 year cones recorded in January was regarded as the product of the previous year's attraction to the first year cones since no new infestations occur during January–March of the second year. A cone examination from the Montara Mts. (San Mateo Co.) added support to this observation. In January 1968, 600 cones from each of the first three age groups (i.e. 1, 1.5 and 2) were examined for infestations of *E. conicola*. In the 1 year group there were no infested cones. In the 1.5 and 2 year groups there were five and 18 infestations respectively. After March, when the anobiid begins to deposit the first eggs of the year, cones of the 1.5 year group became quite attractive to ovipositing females as evidenced by the 34 infested cones recorded in April 1971 from this age group.

FEEDING HABITS.—*Ernobius conicola* displayed specificity in its selection of individual host trees. It was common to find infested trees immediately adjacent to trees experiencing little or no evidence of the insect. Infestation levels varied greatly among the trees sustaining attacks.

Part of this preferential selection may have been related to the spatial arrangement of the cones (i.e. tightly vs. loosely packed in a cluster). Although consistent for a given tree, this parameter tended to vary within the species as a whole. In general, it seemed that *Ernobius* preferred to infest trees whose cones were tightly arranged in clusters.

NEW AND MATURE CONES.—In developing (1 and 1.5 year) and mature



FIGS. 1-3. *Ernobius conicola*. FIG. 1. Larva feeding in mature cone of *Cupressus macrocarpa*. FIG. 2. Pupa in mature cone of *C. macrocarpa*. FIG. 3. Adult.

TABLE 1. Number of *Ernobius*-infested cones from collections made at Cypress and Pescadero Points in Monterey County, Calif.

Date	Cone Age ^b (yrs):	Number of Infested Cones ^a				
		1	1.5	2	3	>3
Jan. 1972		0	10	18	34	—
Apr. 1971		0	34	21	—	5
Aug. 1966		1	— ^c	16	—	—

^a 200 cones dissected from each cone age class on each date.

^b See text for description of cone age classes.

^c Based on classification scheme, this age group is not represented at this time.

(2 year) cones, first instar larvae usually entered via the basal portion of the cone³. In the January 1972 sample (Table 1), 23 of 28 infested cones were invaded through the base. Entrance into the five remaining cones was gained through the side. After the new larvae had successfully penetrated the epidermis, they began to extrude fine powdery frass which accumulated around the small entry holes.

Upon establishment within the cone, the young larvae were generally found feeding in the external portion of the scale tissue. If the cones were relatively free of other invaders, then *Ernobius* fed locally in one or occasionally two scales. Movement between scales seemed to occur only when the substrate was in short supply due to a multiple infestation by several other cone invaders.

DETERIORATING CONES.—As the mature cones aged or when they became occupied by additional invaders, the feeding site of *Ernobius* changed owing to a depletion of available food substrate. This occurred most frequently during the 3 year stage and resulted in a shift of feeding activities to the fibrous cone core. It is of interest that the core was also the site where resinous deposits persisted for the longest periods of time, regardless of the infestation history of the cone.

In no instances were the cypress seeds fed upon by *Ernobius*.

In some of the cones, more than one developmental stage of the beetle was found. Of 139 *Ernobius*-infested cones examined from all age groups (Table 1), 115 were infested with one stage, 19 with two stages, four with three stages and one cone contained four stages. Most of the cones containing more than one individual appeared to have been invaded independently as evidenced by the mixture of different larval instars, pupae and/or adults that were extracted. In addition, the near-equal frequency of first instar larvae in newly-infested vs. previously-

³ Eggs are oviposited in secluded sites at the base of developing or mature cones and between dried scales of senescent cones.

infested cones suggests that gravid females oviposited without regard to previous infestation history.

COHABITING INSECTS.—*Ernobius conicola* was often found associated with two lepidopterous species, *Laspeyresia cupressana* (Kearfott) (Tortricidae) and *Henricus macrocarpana* Walsingham (Phaloniidae) in the cypress cones. Cohabitation of *Ernobius* with one or rarely both moth species can be explained on the basis of cone age preferences, feeding habits, and seasonal histories of *Henricus* and *Laspeyresia*.

In the case of *H. macrocarpana*, larvae were found infesting mostly first year, unpollinated cones, wherein they fed almost exclusively on the developing seeds (Frankie and Koehler 1967). New larvae entered the soft 1 year cones during June and remained in the larval stage until March or April of the following year. At that time the cones were 1.5 years of age. From late April through May of the second year, adults of *Henricus* emerged from the cones. Simultaneously, the first instar anobiid larvae began to invade 1.5 as well as the 2 and 3 year cone groups. Except for this brief two month overlap period, the two species remained relatively isolated from each other due to their respective preferences for cones of different ages. Since *Henricus* females as well as the anobiid females are believed to oviposit randomly on the cones, regardless of whether the cones are predisposed or intact, opportunities for cohabitation are further diminished. An examination of cones of the 1 and 1.5 year groups revealed that only three of 45 infested with *Ernobius* were concurrently invaded by *Henricus*.

Larvae of *L. cupressana* were found feeding almost exclusively in the scale tissue of 1, 1.5 and 2 year old cones (Frankie and Koehler 1971). The larvae tunnel randomly through the scales, resulting in a substantial amount of feeding in the interior of the cones. In contrast, *Ernobius* feeds locally in the exterior of cones of these age groups. Of 85 *Ernobius*-infested cones examined in the above three age classes, 15 were found to contain stages of both the beetle and the moth. Periods of coexistence between *Ernobius* and *Laspeyresia* are probably short-lived if cones become over-crowded with phytophagous individuals. Under conditions of food shortage (or perhaps through water stress in the cones brought about by multiple invasions) *Laspeyresia* is thought to move to adjacent cones in search of more favorable substrate (Frankie and Koehler 1971). Therefore, due to differences in preferred feeding sites and the response of *L. cupressana* to crowded conditions, the cohabitation seemed to pose no problem to either of the two species.

Old infestations of either lepidopterous species and *Ernobius* were easily distinguished primarily on differences in frass particle size. The

larvae of *Laspeyresia* and *Henricus* both produce their frass in relatively large pellets, while *Ernobius* excretes finely shredded frass. An additional difference is that the larvae of both moths tend to pack their frass in certain sections or chambers of their borings whereas the anobiid frass merely accumulates loosely within the hollowed out cone scales.

DISCUSSION

Early reports on *E. conicola* provide little insight into the relationship of this insect to its host, Monterey cypress. Field observations and data from cone dissections reported in this paper reveal that *Ernobius* interacts with its host plant in several specific ways.

Numerous collections indicate that the beetle is limited primarily to Monterey cypress in a limited portion of its range along coastal California. This apparent restricted distribution is similar to the pattern displayed by the scolytid beetle, *Conophthorus radiatae* Hopkins, in its coastal confinement to central California (Schaefer 1963). Further, *Ernobius* is limited to the cones of certain age groups of particular cypress tress.

The apparent tendency of the insect to invade via the base of developing and mature cones also suggests a very specific relationship. Using electroantennogram recordings, a similar interaction was reported by Asher (1970) in reference to the relatively high olfactory response of *Dioryctria abietella* (Denis and Schiffermuller) to volatile compounds escaping from the basal $\frac{1}{3}$ of *Pinus elliotii* Engelman var. *elliottii* cones. However, in the case of *Ernobius*, penetration at the base may indicate an adaptation to seek shelter to avoid harsh coastal climatic conditions which often prevail in the native stands. Such a behavioral pattern may also provide some explanation for the tendency of *Ernobius* to invade trees having cones tightly packed in clusters. Closely aligned cones would aid in protecting the newly hatched larvae.

This study may hopefully raise new questions regarding the biology and ecology of *E. conicola* as well as other anobiid species, most of which are poorly known.

ACKNOWLEDGMENTS

I would like to thank A. E. Darling for assistance in dissecting numerous cypress cones. I am also indebted to H. R. Burke, J. A. Chemsak, R. R. Fleet, D. R. Hamel and C. S. Koehler for reviewing and criticizing the manuscript.

I gratefully acknowledge the cooperation of the following institutions

for supplying me with collection records: California Academy of Sciences, San Francisco; Department of Entomology, University of California, Berkeley; Los Angeles County Museum, Los Angeles; and Smithsonian Institution, Washington, D. C.

LITERATURE CITED

- ARNETT, R. H. 1968. The beetles of the United States. Amer. Entomol. Inst., Ann Arbor, Mich., 1112 p.
- ASHER, W. C. 1970. Olfactory response of *Dioryctria abietella* (Lepidoptera: Phycitidae) to slash pine cones. Ann. Entomol. Soc. Amer., 63: 474-476.
- BAKER, W. L. 1972. Eastern forest insects. U. S. Dep. Agr. Misc. Publ. No. 1175, 642 p.
- BORROR, D. J. AND D. M. DELONG. 1971. An introduction to the study of insects. 3rd Ed. Holt, Rinehart and Winston, N. Y., 812 p.
- ESSIG, E. O. 1926. Insects of western North America. MacMillan Co., N. Y., 1035 p.
- FISHER, W. S. 1919. Five new species of ptinid beetles. Proc. U. S. Nat. Mus., 55: 295-299.
- FRANKIE, G. W. AND C. S. KOEHLER. 1967. Cypress bark moth on Monterey cypress. Calif. Agr., 21: 6-7.
1971. Studies on the biology and seasonal history of the cypress bark moth, *Laspeyresia cupressana* (Lepidoptera: Olethreutidae). Can. Entomol., 103: 947-961.
- HATCH, M. H. 1961. The beetles of the Pacific Northwest. Pt. 3. Univ. Wash. Publ. Biol., 16: 309-327.
- KEEN, F. P. 1958. Cone and seed insects of western forest trees. U. S. Dep. Agr. Tech. Bull. No. 1169. 168 p.
- RUCKES, H., JR. 1957. A synopsis of the California deathwatch beetles of the genus *Ernobius* Thomson, with descriptions of two new species which attack pine cones (Coleoptera: Anobiidae). Pan-Pac. Entomol., 33: 157-161.
- SCHAEFER, C. H. 1963. Factors affecting the distribution of the Monterey pine cone beetle, *Conophthorus radiatae* Hopk., in central California. Hilgardia, 34: 79-103.
- WAGENER, W. W. 1939. The canker of *Cupressus* induced by *Coryneum cardinale* n. sp. J. Agr. Res., 58: 1-46.
- WHITE, R. E. 1962. The occurrence of *Mesocoelopus collaris* Mulsant and Rey in Columbus, Ohio, with biological notes (Coleoptera: Anobiidae). Coleopt. Bull., 16: 13-15.
- WOLF, C. B., AND W. W. WAGENER. 1948. The new world cypresses. El Aliso, 1: 1-444.

Biology of the Spider *Diguetia imperiosa*¹

(Araneida: Diguetidae)

MICHAEL M. BENTZIEN²*Department of Ecology and Systematics, California State University, San Francisco*

Spiders of the family Diguetidae have a unique type of web and cocoon construction. They spin a sheet web surrounded by a tangled mesh of silk threads, and build a retreat which serves as protection for the spider, and in the case of females, as an enclosure for the egg sacs. Diguetids are considered to be relatively primitive spiders and the genitalia of both sexes are comparatively simple. The family was established by Gertsch (1949) and also revised by Gertsch (1958). The nine species of the family all belong to the genus *Diguetia* and are distributed from the southwestern United States through Mexico, and also occur in western Argentina. Although the diguetids are often locally abundant, few studies of their biology have been made. Cazier and Mortenson (1962) studied the biology of *Diguetia canities* near Portal, Arizona; Gerschman de Pikelin and Schiapelli (1962) described the web structure of *D. catamarquensis* in Argentina, and Eberhard (1967) studied attack and prey-wrapping behavior in *D. albolineata*.

In August 1968 I had the opportunity to make field studies of *D. imperiosa* Gertsch and Mulaik (Fig. 1), a species distributed widely through the southwestern United States and northern Mexico. Field work done in the Cuatro Ciénegas Basin of Coahuila, Mexico. Spiders and retreats were brought to California for observations on behavior and reproductive biology.

METHODS AND MATERIALS

To study habitat, web structure, and behavior of *Diguetia imperiosa* in the field, twenty webs were located, marked, and observed from 9 to 14 August 1968.

To determine fecundity and details of retreat construction, 45 retreats and the spiders accompanying them were collected on 14 August and were fixed and preserved using the methods recommended by Williams (1968). Egg counts and dissection of retreats were done using a binocular dissecting microscope, and measurements were taken with an

¹ This work is based on research for the degree of Master of Arts completed at California State University, San Francisco in 1970.

² Present address: Division of Entomology, University of California, Berkeley, California 94720.

ocular micrometer. Maturity of female spiders was determined by examination of the ovaries.

Ninety retreats with the accompanying spiders were collected on 15 August 1968 and were reared in the laboratory until 31 December 1969. Ten female spiders were allowed to construct webs in small bushes simulating vegetation in the natural habitat; the remainder were confined in small plastic boxes. Laboratory temperatures varied from 20° to 30° C and an approximate 12 hour photoperiod was maintained. Food (*Tenebrio molitor* larvae and adult *Drosophila* sp.) and water were offered at weekly intervals.

Stridulation was recorded with a Sennheiser microphone and a Nagra IIIB tape recorder (15 inches per second). A sound spectrogram was prepared using a model 661-B Sona-Graph manufactured by the Kay Electric Company.

RESULTS

STUDY AREA.—Field work was carried out seven kilometers southwest of the town of Cuatro Ciénegas de Carranza, Coahuila, Mexico. Cuatro Ciénegas lies in an intermontane basin on the east edge of the Mesa del Norte. The basin measures about 30 by 40 km. An arid Chihuahuan climate prevails, but large numbers of springs give rise to complex systems of internal drainage within the basin. Minckley (1969) has summarized biological research in the Cuatro Ciénegas area.

The study area consisted of low dunes and flats. The dunes were stabilized and of high gypsum content. The flats had powdery soil and were only slightly elevated above the water table; it appeared that flooding was of seasonal occurrence. Zonation of the soil was lacking, and vegetation was sparse. Flats were primarily vegetated by chenopods (*Allenrolfea occidentalis* (Wats.) Kuntze, *Suaeda* spp.) and unidentified sedges. Dunes supported yucca (*Yucca* sp.), mesquite (*Prosopis glandulosa* Torr.), ocotillo (*Fouquieria* sp.), and two species of *Opuntia*.

WEB AND RETREAT STRUCTURE.—*Diguetia imperiosa* constructed its web in spaces between the branches of low plants, or suspended it between adjacent plants. All webs observed were less than one meter above the ground. Orientation of the web appeared to be non-random; 75 per cent of the webs observed were suspended on the west facing side of the supporting plants.

The web invariably was composed of four structural parts (Fig. 2). Hereafter, the term "web" will refer to the entire web, and the term "webbing" will refer to the various parts of the web. The parts of the

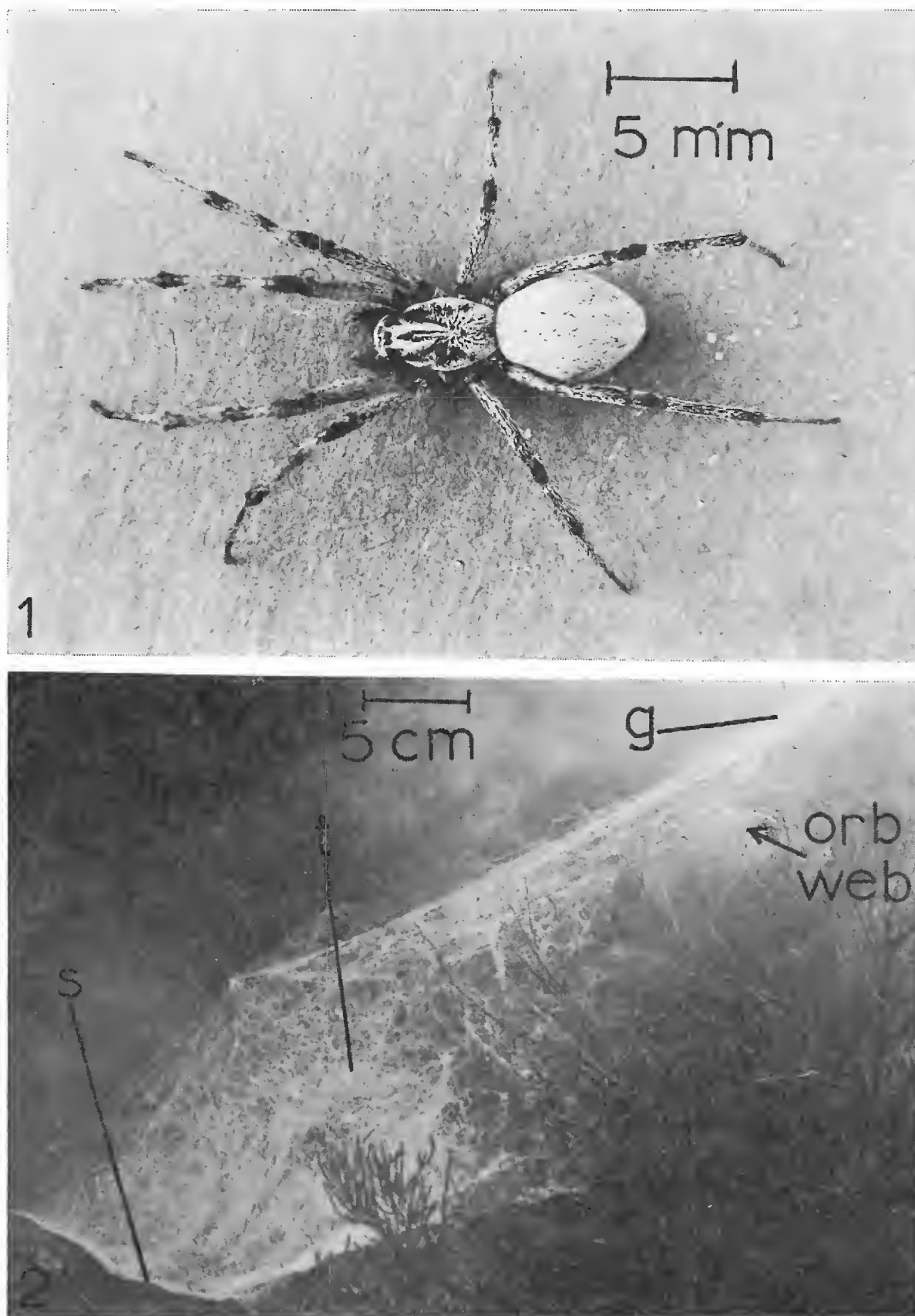


FIG. 1. Adult female *Diguetia imperiosa* Gertsch and Mulaik from Cuatro Ciénegas de Carranza, Coahuila, Mexico. Photo by Carolyn Cavalier. FIG. 2. Web of female *Diguetia imperiosa* near Cuatro Ciénegas de Carranza, Coahuila, Mexico. Guy lines (g), tangle webbing, and sheet webbing (s) are visible. Orb web of *Metepeira* sp. is located in upper right portion of *D. imperiosa* web.

TABLE 1. Accessory materials used by *Diguetia imperiosa* in retreats construction. Analysis based on dissection of 30 retreats collected 15 August 1968 near Cuatro Ciénegas de Carranza, Coahuila, Mexico.

Material	No. of retreats	% occurrence
Plant Material		
Leguminosae: <i>Prosopis glandulosa</i> Torr.	24	80
Cactaceae: <i>Opuntia</i> spp.	3	10
Cyperaceae: unidentified sedge	4	13
Chenopodiaceae: <i>Suaeda</i> spp. and <i>Allenrolfea occidentalis</i> (Wats.) Kuntze	7	23
Arthropod Material		
Arachnida: <i>Diguetia imperiosa</i> exuvia	8	26
Salticidae	1	3
Araneidae	1	3
Insecta: Coleoptera: Oedemeridae: <i>Oxacis</i> sp.	14	47
Scarabeidae	9	30
Bostrichidae, Coccinellidae, Curculionidae, Tenebrionidae	4	13
Hymenoptera: Myrmicidae: Myrmicinae	14	47
Orthoptera: Acrididae	4	13
Lepidoptera: unidentified moths	4	13
Diptera: Muscidae	1	3
Hemiptera: Coreidae, Corixidae, Pentatomidae	3	10
Homoptera: Cicadellidae	4	13
Cercopidae, Psyllidae, Cicadidae	3	10

web were the guy lines, the tangle webbing, the sheet webbing, and the retreat. The guy lines extended to the apices of the branches of the supporting plant and provided suspension for the web. They consisted of multiple strands of heavy silk. The tangle webbing consisted of an irregular mesh of silk which filled the area above and below the sheet webbing. The sheet webbing consisted of a fine silk mesh radiating horizontally from the centrally positioned cocoon; it was oval to roughly circular in shape and was no greater than 0.3 m² in area. Neither tangle nor sheet webbing consisted of viscid silk. Each spider had one retreat associated with its web. The retreat was of a characteristic conical shape, and was open at the lower end. It was suspended by strong strands of silk which were connected to the guy lines and to plant branches, and always hung vertically in the web. The internal diameter of the retreat was sufficiently large to allow the spider to completely

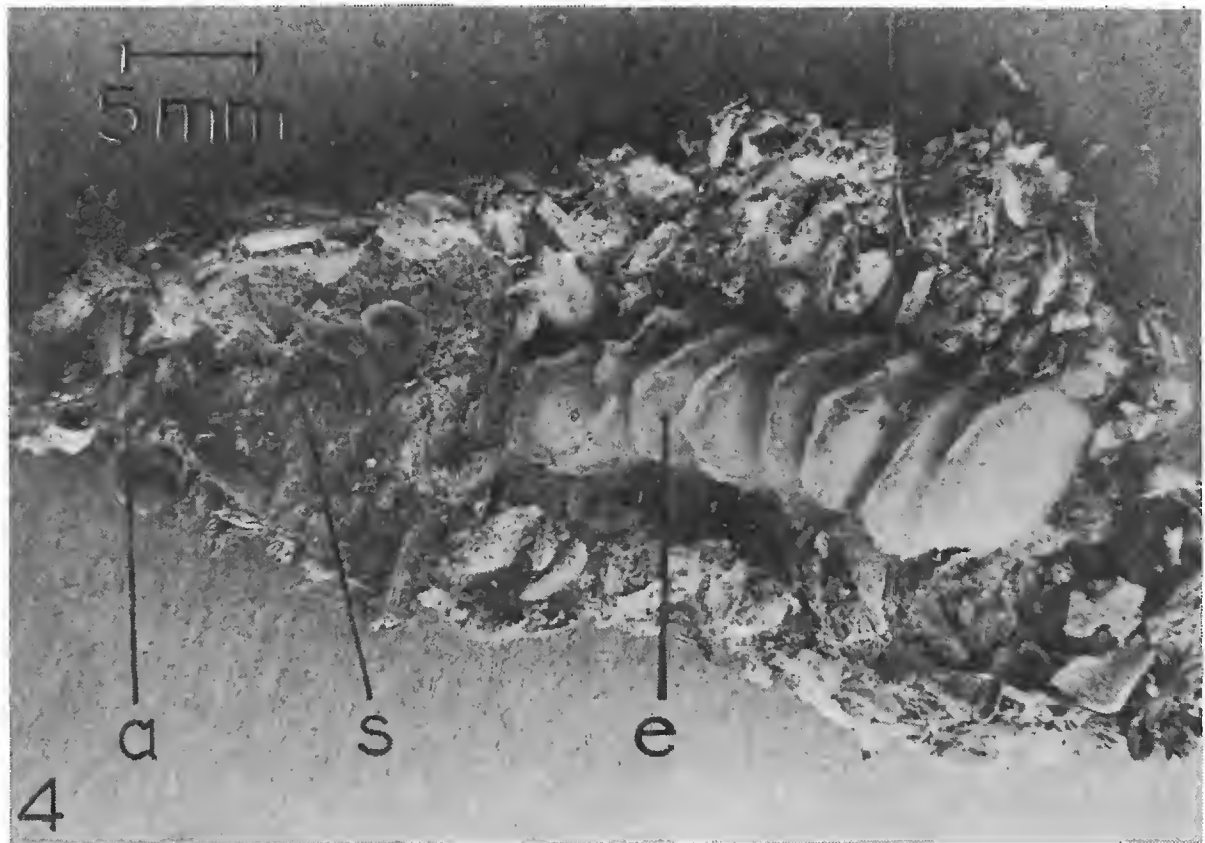
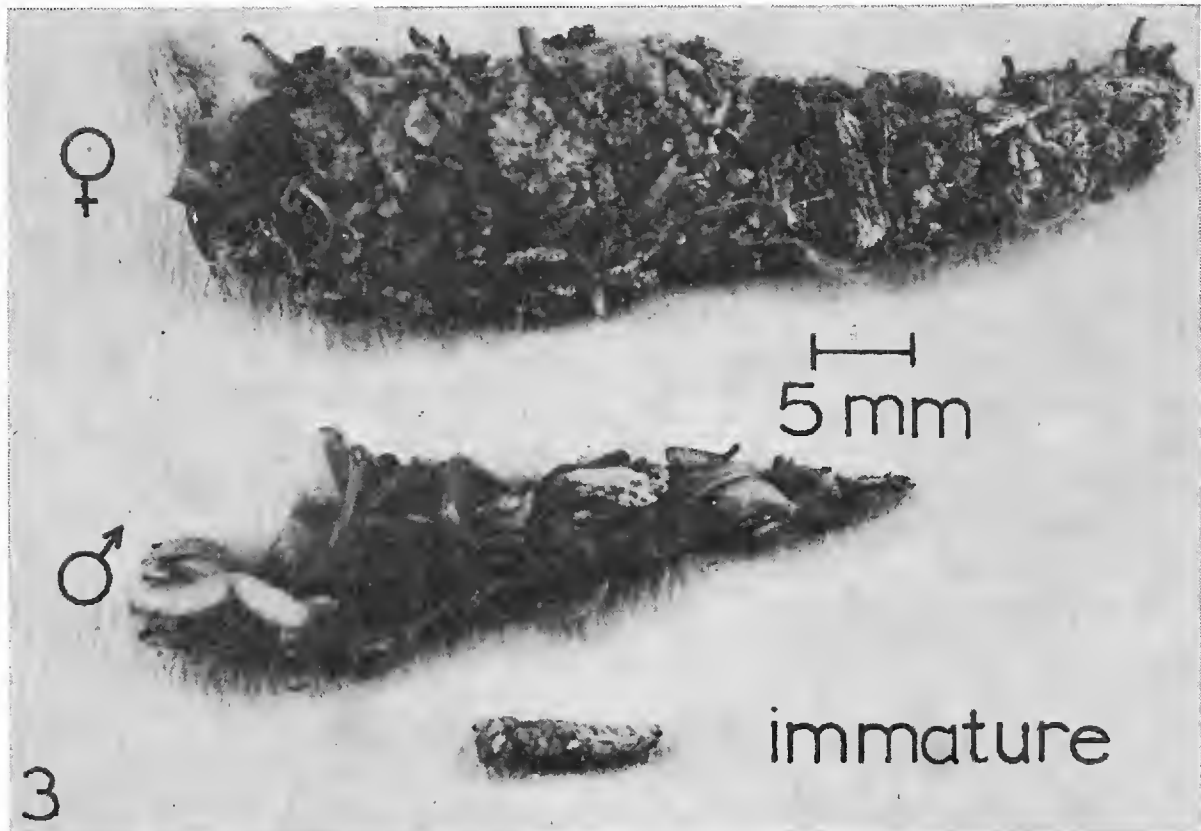


FIG. 3. Retreats of female, male, and immature *Diguetia imperiosa*. FIG. 4. Retreat of female *Diguetia imperiosa*. Opened retreat shows egg sacs with silk cover removed. a = accessory materials, s = silk mesh, e = egg case.

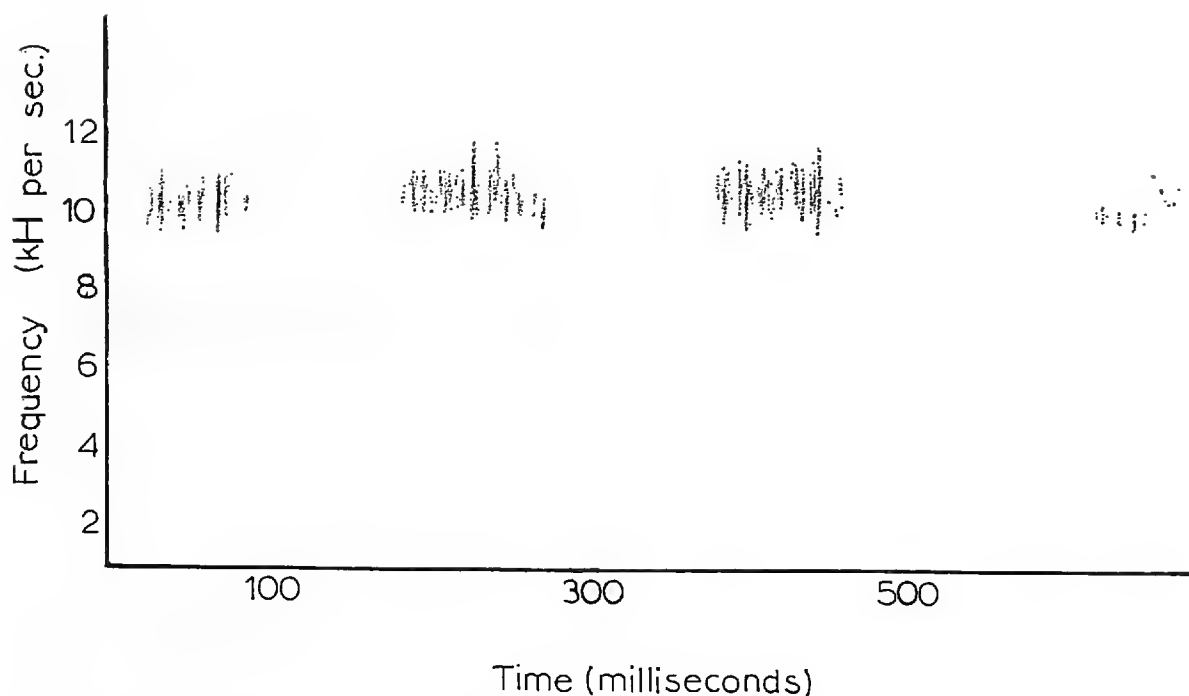


FIG. 5. Sound spectrogram of stridulation of adult female *Diguetia imperiosa*, recorded in laboratory 15 December 1968.

enter; access was from the underside of the sheet webbing. The retreat was constructed of accessory materials, such as plant leaves, insect bodies, and other objects, tightly bound together with a fine silk mesh (Fig. 3). Mature females laid a series of egg sacs inside the retreat in an overlapping, shingle-like arrangement (Fig. 4). The first egg sac laid was placed near the upper, closed end of the retreat. The egg sacs were disc-shaped and about 8 mm in diameter. They were formed by two densely woven discs of silk weakly joined at their peripheries. Each egg sac was covered with a coarse silk mesh with the strands spaced widely enough to allow free passage of emerging spiderlings.

Retreats of mature females were larger and of more tightly woven construction than the retreats of males. Retreats of immature spiders were constructed of materials of smaller, more uniform size than the retreats of mature spiders (Fig. 3).

To determine what accessory materials were used in retreat construction, 30 retreats were dissected. Leaves and twigs of mesquite (*Prosopis glandulosa* Torr.) and Chenopodiaceae were the commonest plant materials, and oedemerid beetles (*Oxacis* sp.) and ants were the commonest insects (Table 1).

BEHAVIOR OF SPIDERS IN THE WEB.—*Diguetia imperiosa* was primarily nocturnal, remaining inside the retreat during the day. However, spiders left the retreat at any hour, day or night, to capture prey. They also left the retreat during the period of midday high temperature, which

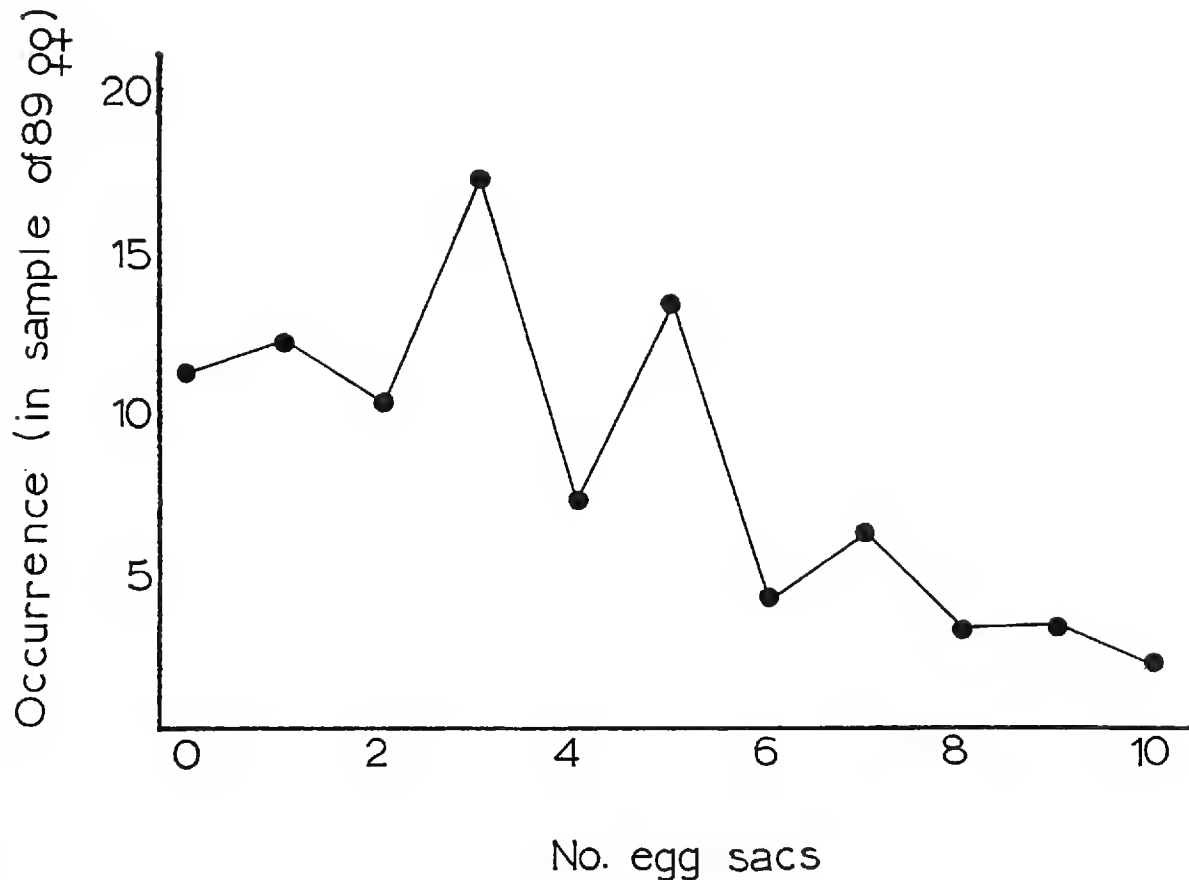


FIG. 6. Occurrence of egg sacs in 89 retreats of female *Diguetia imperiosa*.

reached as much as 47° C during the field study. At this time the spiders positioned themselves in the web so that they were in the shadow cast by the retreat. Later in the afternoon the spiders always returned to their retreat. It was not determined if spiders would leave the retreat at midday on cool or overcast days. At dusk, spiders again left the retreat and remained exposed on the underside of the sheet webbing during the hours of darkness. To study web-building techniques of *D. imperiosa* in the field, the webs of two adult females were removed on 12 August. The spiders and their retreats were left in the supporting plants. The spiders replaced the guy lines supporting the retreat first, then erected guy lines to support the sheet and tangle webbing. Spinning of sheet and tangle webbing followed; but three days later, when field observations ceased, only sparse webs had been constructed. The incomplete nature of the sheet and tangle webbing suggested that prey capture would have been severely reduced.

In the laboratory, spiders began to construct webs in the same manner as individuals in the field, but after a month they still had not constructed complete webs.

Diguetia imperiosa reacted to web disturbance in three different ways. Slight movements in any part of the web induced attack behavior.

Disturbances of a greater magnitude, involving significant movement of the entire web, caused spiders to withdraw into the retreat. This response occurred when capture of spiders was attempted in the field. Sudden severe disturbance to the whole web, or destruction of the web, caused spiders to drop from the web and remain motionless on the ground in a death feigning posture, in which the legs were drawn close to the body, and no movement occurred for as long as 45 minutes. Spiders later returned to the web area by climbing the nearest plant. No drag lines were established in these abrupt falls from the web.

Two webs in the study area each contained a male-female pair of spiders. In both of these webs the female had already deposited eggs, and no mating activity was observed. When prey entered the webs of these paired spiders, females attacked and handled the prey in the usual manner, but males did not respond. When disturbed, in each case the females withdrew into the retreat in the same way as single females, but the males ran about the web. In one instance a male did attempt to enter the female's retreat after she had withdrawn, but he emerged almost immediately.

Prey became trapped either in the tangle webbing or on the sheet webbing. When prey entered the web, the spider ran out on the underside of the sheet webbing toward the source of disturbance. In a few instances, spiders shook the sheet webbing when approaching prey. If prey remained trapped in the tangle webbing, spiders had to climb into the tangle webbing to attack. In this situation, a spider would run to the edge of the sheet webbing to ascend the tangle webbing; no use of holes in the sheet webbing to pass from one side to the other was observed. In most of the prey captures observed in the field, the spiders encountered and attacked prey on the sheet webbing. Spiders attacked from the underside of the sheet webbing in these cases. The first pair of legs were extended through the sheet webbing to hold the prey down while it was bitten through the sheet webbing; the hold on the prey was then released. When the prey ceased struggling, the spider cut a hole in the sheet webbing with the chelicerae, and pulled the prey through to the underside of the sheet webbing.

When prey capture occurred at night, feeding took place in an exposed position out under the sheet webbing, but prey captured during the day was carried to a location just beneath the retreat to be eaten.

When spiders captured large winged insects, a simple form of prey wrapping occurred. The prey was suspended from a silk line and rotated while a few turns of silk were used to bind the wings. Small prey was

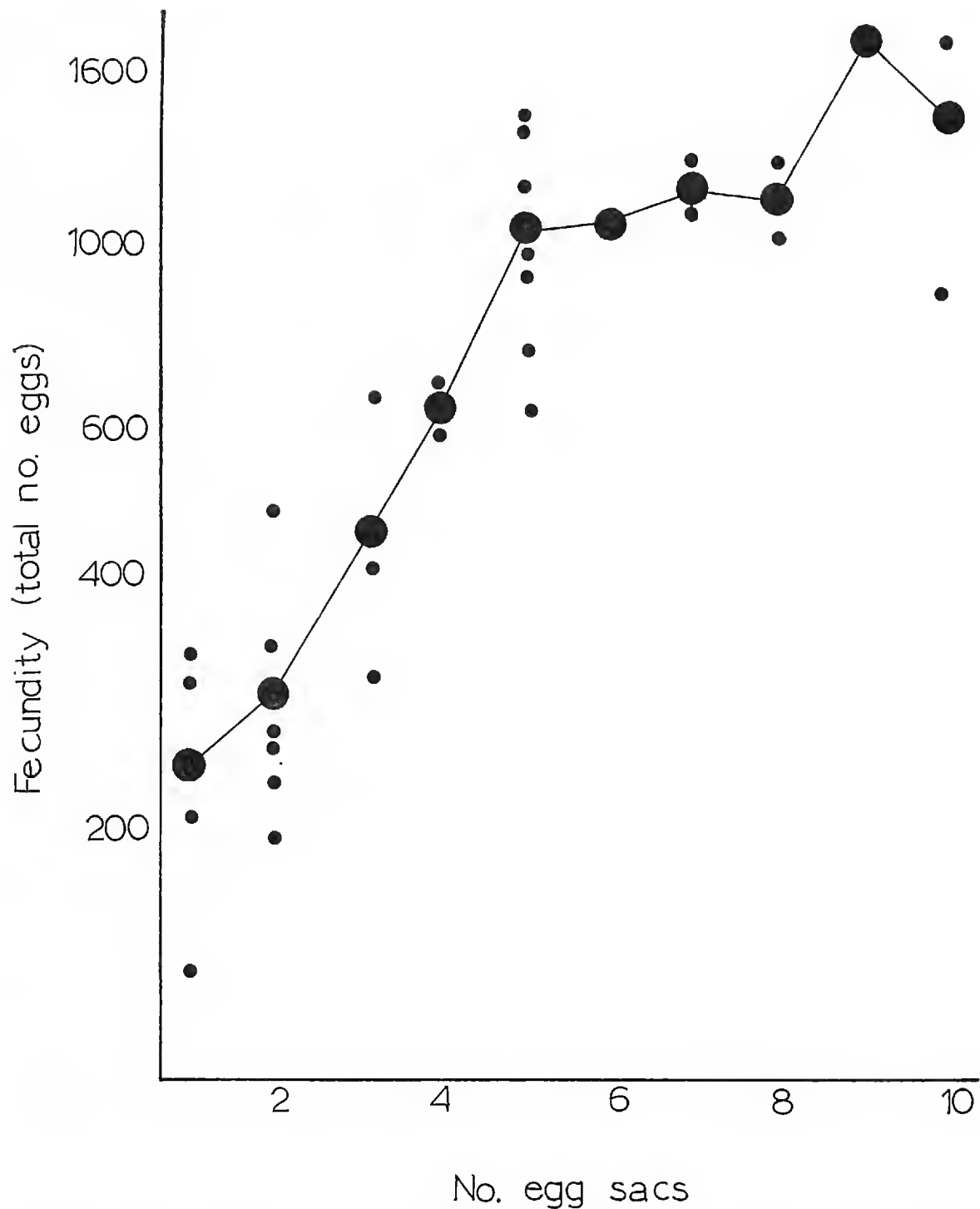


FIG. 7. Egg production of 30 female *Diguetia imperiosa*. Small dots represent totals of individual retreats; large dots represent mean totals.

captured and eaten without the use of silk. Prey wrapping was also observed when an insect became trapped in the web while the spider was feeding on previously captured prey. The first prey was suspended and wrapped; then the spider attacked the new prey.

When a nonprey item such as a piece of plant material fell onto the sheet webbing, spiders discarded the item after a few seconds of exploratory contact using the pedipalps and first pair of legs; a hole was

cut in the sheet webbing with the chelicerae and the object was permitted to drop to the ground.

Attack behavior of captive *D. imperiosa* did not differ from that observed in the field.

STRIDULATION.—Stridulation was observed in several adult female *D. imperiosa* in the laboratory when the spiders were physically disturbed, as when grasped by forceps. The stridulatory mechanism in the genus *Diguetia* consists of fine grooves on the outer face of the paturon of the chelicerae, which serve as a file, and a row of small tubercles on the prolateral side of the femur of the pedipalp, which serve as a scraper. During stridulation, the chelicerae are spread and the pedipalps are simultaneously rapidly raised and lowered. In *D. imperiosa*, the resultant sound occurred in bursts lasting for 75 milliseconds, separated by 100 millisecond intervals. The frequency averaged about 10,000 Hertz (Fig. 5). Males had fewer and smaller femoral tubercles than females, but no live males were available for recording stridulation.

ASSOCIATES.—Two species of spiders were directly associated with *Diguetia imperiosa* webs in the field. Immature spiders of an undetermined species of the araneid genus *Metepeira* were found as a commensal in 25 per cent of the *D. imperiosa* webs examined in the field. *Metepeira* constructed a small orb web in the upper tangle webbing of the host spider. These orb webs were less than five centimeters in diameter and were vertically oriented. No mature *Metepeira* were found associated with *D. imperiosa*.

Two webs examined in the field each contained an individual of an undetermined species of the genus *Mimetus*, spiders predaceous on web building spiders. In both cases the *D. imperiosa* which had constructed the web was missing.

No parasitization or predation of egg sacs was found.

REPRODUCTIVE BIOLOGY.—Descriptive terms of development are those used by Hite *et al.* (1966). Eggs of *D. imperiosa* were white, spherical, and varied from 0.45 to 0.55 mm in diameter. When eggs hatched a first stage postembryo emerged. This first stage postembryo was covered with a thin membrane through which the developing spider could be seen. The first stage postembryo was yellowish white except for black eyes, and ranged from 0.53 to 0.62 mm in length. The second stage postembryo was free moving and possessed tarsal claws, but lacked development of cheliceral fangs and body pigment. This stage ranged from 0.80 to 0.90 mm in length. The next molt gave rise to spiderlings with fully developed claws, chelicerae, and body pigmentation resembling that of the adult. The range in body size was the same as the

TABLE 2. Egg production by *Diguetia imperiosa*. Based on egg sacs contained in seven retreats, each with five egg sacs, collected 14 August 1968. Number of eggs and young in each sac is represented.

Egg sac (oldest to newest)	Individual						
	#102	#103	#104	#130	#134	#135	#137
(first egg sac laid)	70	236	181	262	321	415	190
	200	217	261	206	269	367	148
	178	162	253	208	222	268	110
	167	152	200	125	244	241	151
(last egg sac laid)	206	128	246	140	289	75	107
mean	164	179	228	188	269	273	141

F-Test Analysis

Source of variation	DF	Sum Squares	Mean Square	F	P
total	34	197622			
retreat	6	79848	13308	3.56	$P < 0.01$
position of egg sacs	4	28040	7010	1.87	$P < 0.05$
error	24	89734	3738		

second stage postembryo. Development to the spiderling stage occurred within the egg sac. The first and second stage embryos were inactive, developmental stages, while the spiderlings were capable of feeding and silk production. Spiderlings escaped from the cocoon by splitting the egg sac along the loosely joined peripheral seam. The emergence of spiderlings from the retreats took place in the laboratory from 22 August to 23 September 1968. At this time emergence had occurred in only 43 per cent of the 56 retreats containing eggs. No emergence occurred after 23 September. Nonemerged spiderlings remained alive inside the egg sacs until December 1968. After this time all had died. Twenty-six per cent of the living females continued laying eggs until 23 September, 1968, whereas complete emergence from all egg sacs had already occurred in four per cent of retreats containing eggs collected on 14 and 15 August. Eggs laid in the laboratory failed to develop beyond the first stage postembryo.

Maturity of female spiders collected was determined either by the presence of eggs in the accompanying retreat or by examining the ovaries. In a sample of 30 mature females, the number of eggs laid per female ranged from none to 1,675, and the mean was 734. The egg sacs of 89 female retreats were counted. The number of egg sacs constructed per female ranged from zero to ten, with a mean of 3.6. Only 20 per cent of the females laid more than five egg sacs (Fig. 6).

Considerable variability existed in the numbers of eggs laid in subsequent egg sacs by the same spider. Some females laid progressively fewer eggs in later egg sacs, but others laid increasing numbers. Spiders which laid the same number of egg sacs during the reproductive season showed much variability in the egg number of corresponding egg sacs in the sequence, as well as in total number of eggs laid. This was shown by seven spiders which laid five egg sacs each (Table 2). Differences in the total number of eggs laid was highly significant ($F = 3.56$; $P < 0.01$). Based on the relative position within retreats, number of eggs laid in the corresponding egg sacs by the seven spiders, there was no pattern of increase or decrease in egg laying by these spiders ($F = 1.87$; $P > 0.5$). Similar results were found in a group of three spiders which laid three egg sacs each; there was a significant difference in total egg number laid by individual spiders ($F = 10.7$; $0.05 > P > 0.01$), and the group showed no pattern of differential egg laying in relation to the sequence of egg sacs ($F = 0.414$; $P > 0.05$).

No correlation was found between size of female spiders (carapace length) and total egg production, nor was there any indication of decreasing fertility in the later egg sacs.

Egg counts carried out on a sample of 30 retreats containing eggs showed that spiders laying over five egg sacs did not greatly increase their egg production over those which had laid only five egg sacs (Fig. 7). But egg production decreased sharply in spiders laying fewer than five egg sacs.

Of the 135 retreats collected, 89 had been built by females, 37 by males, and five by immature spiders. Of the 82 *Diguetia imperiosa* found with these retreats, 73 were mature females, four were mature males, and five were immature.

DISCUSSION

Since nearly all the *Diguetia imperiosa* collected were mature, the spider probably has an annual life cycle, with one brood per year. A few females captured at maturity lived up to two additional years in the laboratory, but they did not molt, and became very inactive.

Stridulatory mechanisms of several types are widespread in spiders. In certain of the Theraphosomorphae stridulation occurs when the spider assumes a defensive posture, and the sound is readily audible to humans (Savory, 1928). Many araneomorph spiders have stridulatory organs, but the nature of the sound produced is generally unknown. The stridulation of *Diguetia imperiosa* is faintly audible to some human observers. As the stridulatory organ is found in both sexes, and since stridulation can be elicited by disturbing the females, a defensive function is indicated.

The lack of egg parasitization was surprising, since a fairly large sample of retreats and egg cases was examined for parasites. Cazier and Mortenson (1962) found both hymenopteran and coleopteran egg parasites of *Diguetia canities*, and five out of 75 retreats of *Diguetia* sp. from Yavapai County, Arizona sent to me by Dr. Cazier contained hymenopteran parasites. Suitable parasites may be absent in the Cuatro Ciénegas Basin, or parasites may have been operating at a low level when this study was done.

ACKNOWLEDGMENTS

My thanks to Dr. Mont A. Cazier, who suggested this study and provided help and advice in the field. Dr. Wendell L. Minckley furnished helpful information concerning the Cuatro Ciénegas Basin, and Dr. Donald J. Pinkava made the plant determinations.

I am grateful to Dr. Stanley C. Williams, Dr. Robert I. Bowman, and Dr. Bernard Goldstein for their suggestions and criticism regarding the manuscript. My appreciation to Dr. Williams for the time he generously spent discussing this study and related topics, and to Dr. Bowman for providing facilities to make the sound spectrogram.

Thanks are also due Sandra Ortega for clerical help, and Carolyn Cavalier for help with the photography.

LITERATURE CITED

- CAZIER, M. A. AND M. A. MORTENSON. 1962. Analysis of the habitat, web design, cocoon and egg sacs of the tube weaving spider *Diguetia canities* (McCook). (Aranea, Diguetidae). Bull. S. Calif. Acad. Sci., 61: 65-88.
- EBERHARD, W. 1967. Attack behavior of diguetid spiders and the origin of prey wrapping in spiders. Psyche, 74: 173-181.
- GERSCHMAN DE PIKELIN, B. S. AND R. D. E. SCHIAPPELLI. 1962. La familia Diguetidae en la Argentina. Physis, 23: 205-208.
- GERTSCH, W. J. 1949. American spiders. D. van Nostrand Co., N. Y., 285 p.
1958. The spider family Diguetidae. Amer. Mus. Novitates, 1904: 1-24.
- HITE, J. M., W. J. GLADNEY, J. L. LANCASTER, JR., AND W. H. WHITCOMB. 1966.

- Biology of the brown recluse spider. Arkansas Agr. Exp. Sta. Bull. 711, 26 p.
- MINCKLEY, W. L. 1969. Environments of the Bolson of Cuatro Cienegas, Coahuila, Mexico. Texas West. Press Sci. Ser. 2, 65 p.
- SAVORY, T. H. 1928. The biology of spiders. MacMillan Co., N. Y., 376 p.
- WILLIAMS, S. C. 1968. Scorpion preservation for taxonomic and morphological studies. Wasmann J. Biol., 26: 133-136.

BOOK REVIEW

ECOLOGICAL STUDIES 2. INTEGRATED EXPERIMENTAL ECOLOGY. METHODS AND RESULTS OF ECOSYSTEM RESEARCH IN THE GERMAN SOLLING PROJECT. Edited by Heinz Ellenberg. Springer-Verlag, New York, Inc. 214 p., 53 figs., 44 tables. 1971. \$16.80.

One of the first International Biological Program (IBP) ecosystem studies was initiated in 1967 by the West German IBP Working Group for the Study of Terrestrial Biological Communities. A group of 50 scientists under the direction of Professor Ellenberg undertook an interdisciplinary study in the High Solling in the center of the Federal Republic of Germany. The area contains both forest and grassland ecosystems. This volume presents preliminary reports from many of the cooperative studies with emphasis on the methods used. A final report is expected after the conclusion of the project in 1972.

This volume contains 28 reports produced by 33 scientists. The introductory chapter by H. Ellenberg sets the background for the project by describing its relationship to IBP, the structure and functioning of ecosystems, the organization of the integrated research, and the research area and experimental plots. The remaining reports are subdivided into four major parts: Primary Production; Secondary Production; Environmental Conditions; and Range of Validity of the Results.

Insects are dealt with in four reports in Part 2: Secondary Production. These all involve food and energy turnover of various insects. Sampling techniques for studies of five species of leaf feeding weevils are described by W. Funke, with emphasis on the use of photo-electors (emergence traps). The report by K. Winter presents the approaches used to study some of 40 species of Lepidoptera, most of which are phytophagous on beech trees. Methods used to study energy flow in phytophagous and predatory arthropods are the subject of the report by W. Funke and G. Weidemann. The latter author also reports on the methods used to study population dynamics, standing crop, and production in predatory arthropods of the soil surface.

The basic thrust of the project is to develop a clear understanding of the biological basis of productivity using an integrated approach involving scientists from many disciplines. This volume presents only preliminary results and leaves one anxiously awaiting the production, assimilation and integration of the final reports. The main contribution of the present volume is the description of methodology which provides a valuable background for all ecologists.—ROBBIN W. THORP, *University of California, Davis, 95616.*

A New Species of *Spinolochus* from North America

(Hymenoptera: Ichneumonidae)

TOROLF R. TORGERSEN

*U.S. Forest Service, Pacific Northwest Forest and Range Experiment Station,
Forestry Sciences Laboratory, Juneau, Alaska*

Horstmann (1971) proposed the genus *Spinolochus* in his revision of the European Tersilochinae and included in it a single species, *S. laevifrons* (Holmgren) from northern Europe. A second species has appeared in collections from Alaska, indicating that the genus is Holarctic in distribution and represented by more than one species. The Alaskan species of *Spinolochus* is described below.

Two females of the new species were collected by L. C. Beckwith near Dry Gulch on the Kenai Peninsula southeast of Anchorage, Alaska. The specimens were obtained from windowpane flight traps operated from 1 June to 25 September 1969.

KEY TO FEMALES OF SPINOLOCHUS

1. Ovipositor in dorsal view parallel-sided for most of length, then narrowing abruptly to a subparallel-sided tip, in lateral view smoothly curved and tapering evenly to acute apex; median half of apical margin of clypeus weakly convex; first abdominal tergite in lateral view with slight depression above glymma *laevifrons* (Holmgren)
- Ovipositor in dorsal view parallel-sided to beyond midlength, gradually flaring, then converging smoothly to rounded apex (Fig. 1a), in lateral view with a raised preapical nodus (Fig. 1b); median half of apical margin of clypeus nearly truncate; first abdominal tergite without depression above glymma, smoothly convex or nearly straight above *distolatus* Torgersen, n. sp.

***Spinolochus distolatus* Torgersen, new species ♀**

(Fig. 1a, b)

MALE.—Unknown.

FEMALE.—Front wing 3.5–4.0 mm long, hyaline. Head broad, as wide across eyes as thorax just below tegulae; width across eyes 1.12–1.14× width at temples; profile of face from dorsal aspect elevated medially near antennal fossae. Antenna with 26–29 segments. Clypeus sparsely punctate basally and apically, the median half of its apical margin nearly truncate. Mesoscutum minutely corearious, sparsely punctate; notaulus short and indistinct, anteriorly with rugulose area. Prepectal carina extending dorsally, almost touching mesopleural margin before it curves briefly to nearly parallel it; wrinkling posterior to prepectus near its dorsal extension arranged in several clearly discernible ridges. Area below anterior end of

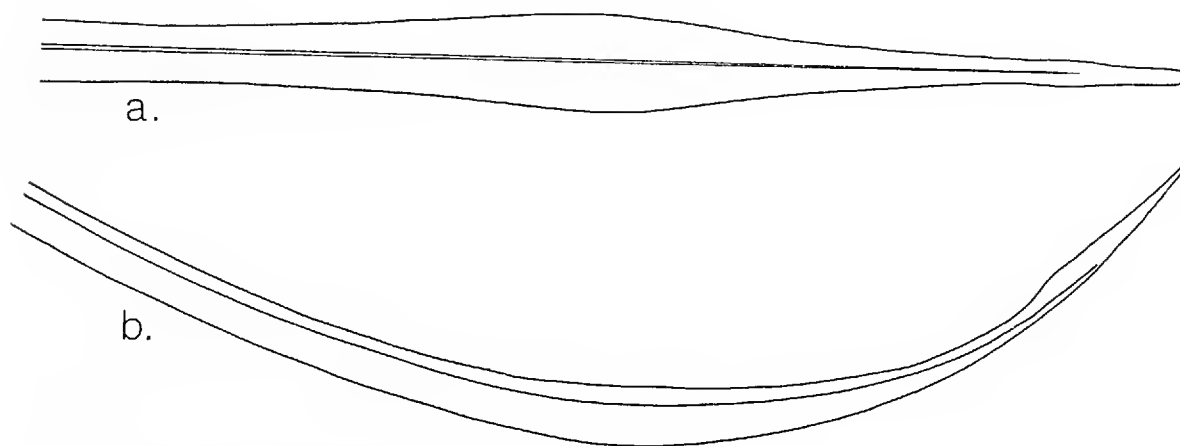


FIG. 1. *Spinolochus distolatus* n. sp.; a, dorsal aspect of ovipositor; b, lateral aspect of ovipositor.

sternaulus rugulose, merging ventrad into coarse punctations then into smooth but weakly mat sternal area. Anterodorsal corner of mesopleurum with rugae clearly arranged in several rows; one to several rugae present in area of mesopleural fovea. Propodeum with areola impressed, not sharply defined; longitudinal carinae represented anterior to petiolar area by irregular rugae. Apical transverse carina of propodeum well developed. First abdominal tergite in profile smoothly convex or nearly straight above glymma. Abdominal tergites 6 and 7 each with deep membraneous excision medially.

Black. Mandible yellow-brown, its teeth and base fuscous. Scape, pedicel, palps, tegula, legs, hind coxa, abdominal segments 2-9, and ovipositor fusco-testaceous. Basal 0.4-0.7 of hind coxa infusate, and hind tarsus a little paler than the rest of legs. Basal margins and/or median areas of abdominal segments weakly infusate or darker red.

In addition to the key characters given for separating *S. laevifrons* and *S. distolatus*, the following may also be helpful in differentiating the two. While the clypeus is nearly uniformly fuscous or black in *S. distolatus*, 0.5 to 0.8 of the apical portion of the clypeus in *S. laevifrons* may be yellow-brown to fusco-testaceous. The abdomen of *S. laevifrons* sometimes is quite dark compared with *S. distolatus*. Also, setation on the ovipositor sheath of *S. laevifrons* is rather sparse as compared with the better developed setation on *S. distolatus*.

Holotype female, DRY GULCH [KENAI PENN.], ALASKA, 25 August 1969, white spruce type, window flight trap, [L. C.] Beckwith, (U.S. National Museum). *Paratype female*, Dry Gulch, Alaska, 28 August 1969, white spruce type, window flight trap, Beckwith (Townes Coll., Ann Arbor, Mich.).

ACKNOWLEDGMENTS

The author expresses his thanks to Dr. Henry K. Townes of the American Entomological Institute, Ann Arbor, Michigan, for his assistance in preparing the above description.

LITERATURE CITED

- HORSTMANN, K. 1971. Revision der europäischen Tersilochinen (Hymenoptera, Ichneumonidae) Teil I. Veröff. Zool. Staatssaml. München, 15: 77-79.

SCIENTIFIC NOTE

Wing dimorphism in *Carabus maeander* (Coleoptera:Carabidae).—The hind wings of this species are usually strongly reduced but sometimes are large and functional (Lapouge, 1929. Wytzman's Genera Ins., 192: 1-747). However, Lindroth (1961. Opusc. Entomol. Suppl., 20: 1-200) did not record long winged forms for this species in Canada and Alaska.

I examined 49 specimens of this species taken in Quebec and I found four long winged specimens from the following places: Argenteuil Co., Ile Carillon, 16 August 1969 (1 male). Beauharnois Co., Baie-de-la-Faim, 27 August 1966 (1 male). Vaudreuil Co., Rigaud, 15 May 1966 and 1 May 1972 (2 males). These long winged forms are geographically restricted to the Montréal region.

Short winged specimens were taken from the following places: Abitibi Co., Amos, 10 June 1962, 13 May and 12 June 1968 (4); Ile Nepawa, 18 June 1968 (1); Lac D'Alembert, 27 May 1968 (4); Lac Figuery, 11 May 1968 (1); La Ferme, 19 May 1968 (1); Mancebourg, 13 June 1968 (4). Charlevoix-Est Co., Baie-Sainte-Catherine, 27 June 1969 (1); Port-au-Persil, 22 June 1969 (1); Port-au-Saumon, 5 July 1964 and 18 July 1965 (2); Sainte-Mathilde, 13 June 1965 (1). Iles-de-la-Madeleine Co., Grosse-Ile, 7 August 1970 (5); Ile-au-Loup, 5 August 1970 (1); Ile du Cap-aux-Meules, 31 July 1970 (1); Ile du Havre-Aubert, 2 August 1970 (4). Montmorency No. 1 Co., Saint-Joachim, 20 April 1968 and 5 June 1969 (2). Saguenay Co., Blanc-Sablon, 4 July 1971 (2); Brador, 7 June 1971 (1); Grandes-Bergeronnes, 31 July 1964 (1); Harrington, 1 July 1971 (4). Témiscamingue Co., Notre-Dame-des-Quinze, 21 May 1968 (1); Rollet, 12 and 24 May 1968 (3). Vaudreuil Co., Rigaud, 15 May 1971 (1).

The geographical distribution of the two forms presents a distinct pattern where concentration of the short winged form indicates an old centrum. Study of wing dimorphism in *Pterostichus anthracinus* Illiger (Lindroth, 1945. Die fennoskandischen Carabidae, 3: 1-911) has shown that the condition of the wings has a hereditary base: short winged forms are dominant, behaving in the simple Mendelian fashion. In consequence, long winged individuals are homozygotes. In a mixed population of a dimorphic species, selection functions in accordance with the completely different means of dispersal of the two forms. During stable periods, when the habitat is exposed to small changes, the short winged forms are advantaged and become more predominant. In unstable periods, the situation is reversed. When a dimorphic species invade new areas, as climate grows better, for instance in late-and post-glacial time, the long winged forms function as groups of pioneering parachutists. Long wing forms of dimorphic species do fly sometimes. Flight power has a positive selective importance in populations living in highly unstable habitats. Stability, restriction and isolation of environments and stenotopy help short winged forms. In fact, *Carabus maeander* lives in highly unstable habitats such as borders of rivers and wet agricultural lands, in the Montréal region.—ANDRÉ LAROCHELLE, Collège Bourget, C. P. 1000, Rigaud, Québec.

A New Species of *Phobetus*

(Coleoptera: Scarabaeidae)

ALAN R. HARDY

*Insect Taxonomy Laboratory, California Department of Agriculture,
Sacramento, 95814*

Investigation of the sand dune habitat in the Southwest has resulted in the discovery of several species of Scarabaeidae, some new (Hardy 1971, Howden and Hardy 1971). Recently a new species of *Phobetus* has been taken in this habitat.

Phobetus was revised by Barrett (1935), and later reworked by Cazier (1937b). With the exception of the description of *Phobetus comatus robinsoni* by Saylor (1939), nothing has since been published on this genus. The following observations concerning species belonging to Cazier's *comatus* group warrant note.

PHOBETUS SAYLORI Cazier

This species was described from a unique specimen taken at Little-rock, Los Angeles Co., California (Cazier 1937a). Cazier (1937b:84) reported an additional specimen from the same locality.

This species has been found in large numbers at Pinyon Flats, Riverside Co., California (also known as Seven Level Hills, Pines to Palms Highway), about 15 miles southwest of Palm Desert. I have examined additional specimens from Morongo Valley, San Bernardino Co., California. Dates of collection are mostly in April, however the range covers from February to May.

Cazier (1937b:77) has discussed the variability in the number of antennal segments of *Phobetus*, but no mention is made of variability in the number of segments of the club. Specimens from the type locality of *P. saylori* have the antennal club composed of three segments, as is typical of the other species of *Phobetus*. The examples from Morongo Valley have the beginnings of an additional segment, as the last segment of the flagellum before the club has become laterally elongated, to about one-third the length of the other segments of the club. This elongation is more pronounced in the Seven Level Hill population, with the segment usually at least three-fourths the length of the club, so that in fact the club could be considered to be four segmented.

Additional segments in the antennal clubs of the Pachydemini are not unusual. The Palearctic genera *Pachydema*, *Hemictenius*, *Tany-*

proctus and *Protoctenius* have five segmented clubs, while *Elaphocera* and *Pachydemocera* have seven segments (Medvedev 1952:17).

Following is a description of a new species of *Phobetus* with a five segmented club.

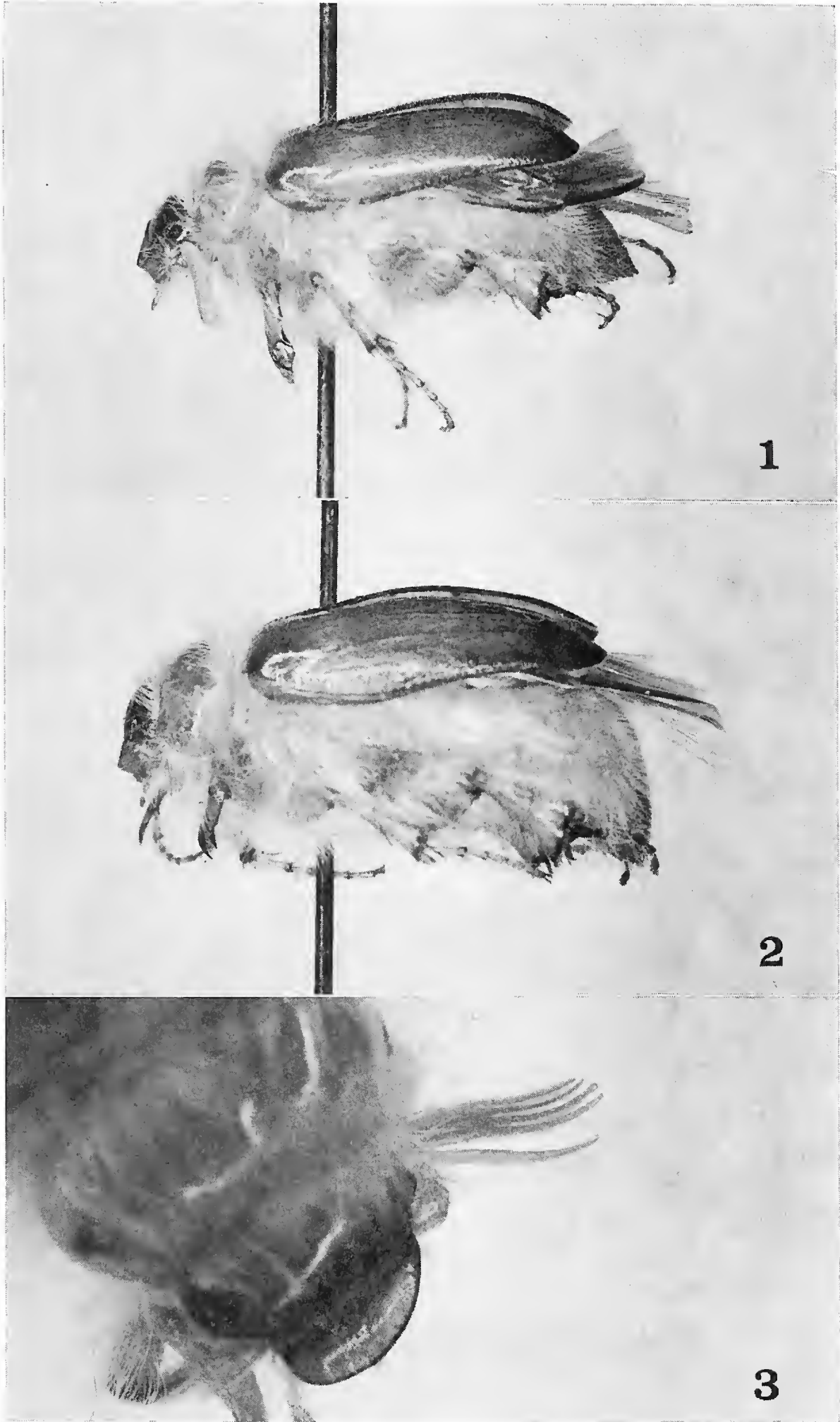
***Phobetus chearyi* Hardy, new species**

Holotype male.—Length 13 mm, width (elytra humeri) 5 mm. *Head*: Clypeus, antennae and ventral surfaces flavotestaceous; vertex rufopiceous. Scape, pedicel, mouthparts, and underside of reflexed anterior surface of clypeus with long white hairs. Labrum bilobed, tumid, produced anteriorly. Clypeus with median longitudinal impression, flanked by round impression on either side. Clypeus with few scattered fine punctures. Front and vertex laterally with scattered to close medium punctures. Antennae with five segmented club. *Prothorax*: Pale flavotestaceous. Disc glabrous, shining, with scattered fine punctures. Margins with numerous long white hairs meeting over top of prothorax. Ventral surface densely clothed with long white hairs. *Scutellum*: With white hairs posteriorly; polished, flavotestaceous; partially obscured by prothoracic hairs. *Elytra*: Disc shining, flavotestaceous, becoming brown at suture and along outer margins. Striae finely punctate, intervals plane with scattered fine punctures, each elytron with few scattered white hairs basally, glabrous apically. Outer margins with short, yellowish hairs, sutural margins with longer white hairs. *Thorax*: Underside densely clothed with long white hairs, polished, shining, flavotestaceous. *Abdomen*: Flavotestaceous, clothed with long white hairs, dense and scattered laterally, medially glabrous except for transverse row of white hairs on midline of each sternite. Pygidium with long white hairs scattered evenly over disc. *Legs*: Anterior femur ventrally with long white hairs, tibia bidentate, third tooth present only as faint projection on outer margin of tibia; tibial teeth testaceous. Apical spur shorter than tibial teeth. Tarsal claws deeply cleft, median tooth as long as outer. Mesothoracic femur with scattered rows of long white setae. Tibia with spiniform medial carina on outer surface, apically with two slender spurs. Metathoracic femur with dense long white hairs on anterior margin, few scattered hairs elsewhere. Tibia with broken spiniform carina on outer face. Corbel with tarsal articulation extended, rising above plane of corbel. Corbel surrounded by fringe of spinules; with two apical spurs, one on either side of channel extending from posterior margin to tarsal articulatory socket. *Male genitalia*: Figure 4.

Allotype female.—Length 14 mm, width (elytral humeri) 5.5 mm. Differs from holotype as follows: Front vertex less punctate, vertex with two well marked depressions. Antennal club shorter, subequal to scape; basal segment only half as long as the other four segments. Elytra proportionately broader (width/length = 0.375, male; 0.421, female). Abdomen massive, much larger than male (see Figs.).

→

FIGS. 1-3. *Phobetus chearyi*. FIG. 1. Holotype male. FIG. 2. Allotype female. FIG. 3. Male antennal club showing five segments.



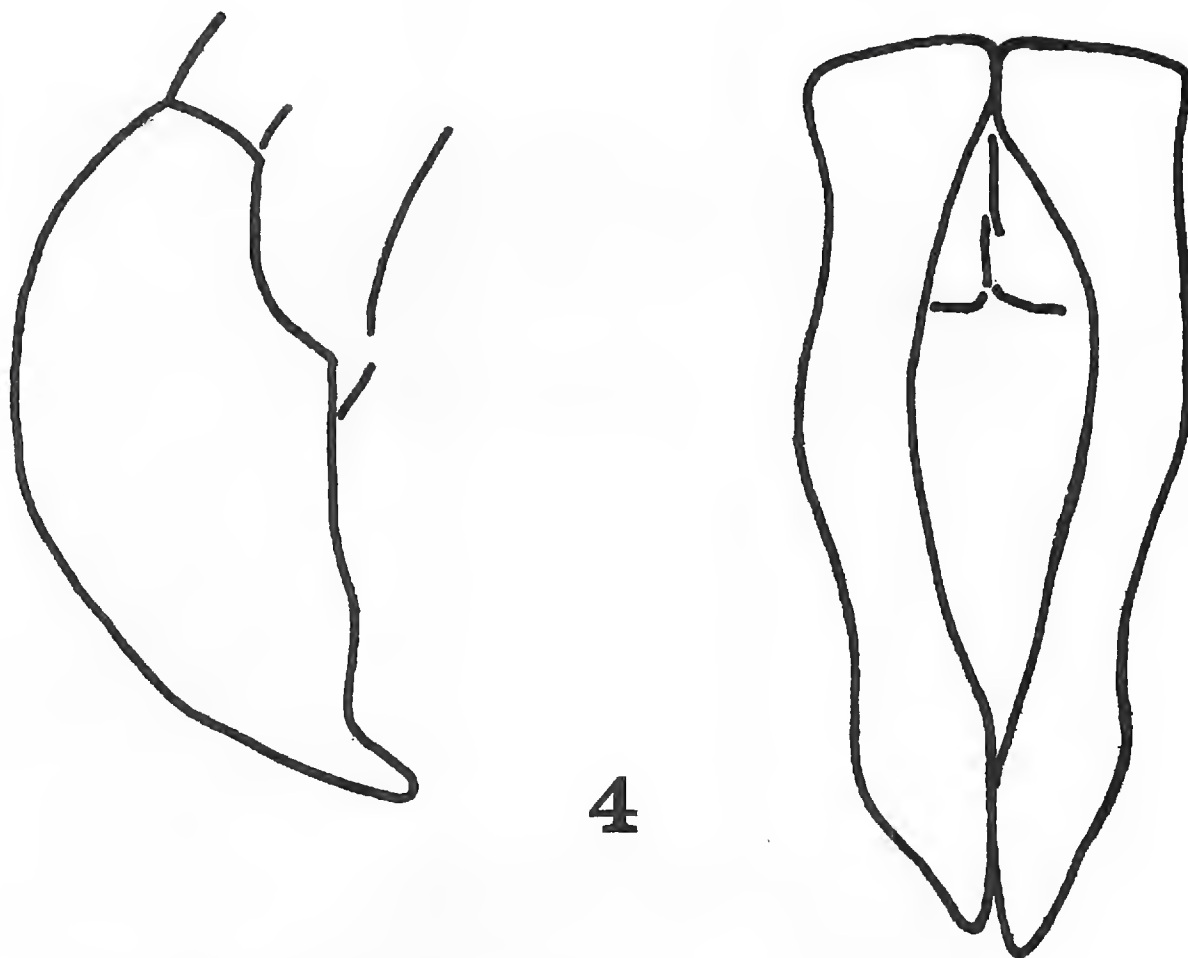


FIG. 4. *Phobetus chearyi*, male genitalia.

VARIATION IN PARATYPES.—Length 11 mm–12.5 mm. Variation appears to be slight, most notable differences are in the coloration and width of the marginal bands of the elytra, the holotype falling at about the midpoint of the range.

DIAGNOSIS.—Best diagnosed on the basis of the five segmented antennal club, but the long pale pubescence and uniformly light coloration make this species easily recognizable.

Holotype male (CAS #11,658), and seven male paratypes, BEACH DUNES, 32 MI. S. SAN FELIPE, BAJA CALIFORNIA NORTE, MEXICO, 25 April, 1970, A. R. Hardy and B. S. Cheary. Allotype and 19 male paratypes, same locality on 6–7 May. Known only from the type locality. Paratypes are deposited in the following collections: California Academy of Sciences, United States National Museum, Canadian National Collection, Museum of Comparative Zoology, American Museum of Natural History, Los Angeles County Museum of Natural History, and the collections of the following individuals: Henry F. Howden, Robert W. Woodruff, Robert W. L. Potts, Brian S. Cheary, and the author.

I take great pleasure in naming this species for Dr. Brian Cheary,

in recognition of his help in collecting the type series, and his fine work as a coleopterist.

The type series was collected on desert sand dunes that were within a few hundred feet of the Gulf of California. In this area the desert vegetation comes right to the beach at the edge of the gulf, where through wind and wave action the sand has been piled into dunes approximately 20 to 30 feet high, and for about one-quarter mile in width. Typical desert vegetation characteristic of the Sonoran Desert, and especially Creosote and Bunch Grass are spotted throughout the hollows and washes of these dunes. The area is fairly rugged and at least five miles of four-wheel drive terrain isolates it from the nearest road. The beetles were collected as they flew into blacklights placed upon the dunes. The individuals would alight upon the sheet and within a very few seconds would rapidly take wing and disappear into the dark. It was thus necessary to sit at each sheet for the flight period with a net, in order to capture the specimens upon their brief visit. The period of activity lasted no more than one-half hour any of the three evenings spent on the dunes, and rapidly ceased as twilight disappeared. The lone female was found crawling on the sand at the base of a large bush, and was not observed to fly, if indeed such a thing is possible for such a large, apparently heavy individual. Extensive sifting of the dunes failed to locate either adults or larvae, and no additional females were collected, although special effort was made to find any present.

LITERATURE CITED

- BARRETT, R. E. 1935. New species of North American Scarabaeidae II. *Can. Entomol.*, 67: 49-52.
- CAZIER, M. 1937a. Four new California Coleoptera. *Pan-Pac. Entomol.*, 13: 115-118.
- 1937b. Revision of the Pachydemini of North America. *Pomona J. Entomol. Zool.*, 29: 73-87.
- HARDY, A. R. 1971. The North American Areodina with a description of a new genus from California. *Pan-Pac. Entomol.*, 47: 235-242.
- HOWDEN, H. F. AND A. R. HARDY. 1971. Generic placement and adult behavior of the genus *Leptohoplia* Saylor (Coleoptera: Scarabaeidae). *Proc. Entomol. Soc. Wash.*, 73: 337-341.
- MEDVEDEV, S. I. 1952. Scarabaeidae, subfamily Melolonthinae, part 2 (cockchafers). *IN* Fauna USSR. Zoological Institute of the Academy of Sciences of USSR, New Series no. 52: 1-274. Moscow and Leningrad. [In Russian]
- SAYLOR, L. 1939. Seven new scarab beetles from California. *Proc. Entomol. Soc. Wash.*, 41: 54-58.

New Species of Trichoptera

D. G. DENNING

2016 Donald Drive, Moraga, California 94556

During the past several years new species of caddis flies have been collected in western United States. Six of these have been selected for description here. Distributional records of several inadequately known species are given. The hitherto unknown immature stages of two species of *Farula* are included. Unless indicated otherwise, types of the new species are in the author's collection.

GLOSSOSOMATIDAE

Glossosoma sequoia Denning, new species

This species belongs to the *alascense-oregonense* section of the *Ripae-glossa* line and is closely related to *C. merica* Denn. Distinguishing characters are the eighth sternite tubercle, the cerci, claspers and aedeagus shield. The coiled thoracic process, which occurs in the males of some species of *Glossosoma*, also contains characters of diagnostic value.

MALE.—Length 8.5 mm. Wings fuscus, except for pterostigma, quite glabrous; head, thorax light brown. The spiral bulbous portion of the prealar coiled thoracic process dark brown. Genitalia as in Fig. 1. Fifth sternite (Fig. 1A) with narrow auriculate-like lobes. Seventh sternum with prominent spatulate dark brown process. Eighth sternum tubercle short, subacute, blackish (Fig. 1B). Tenth tergite completely covered by typical hood-like ninth segment. Cercus and tenth tergite consist of pair of lobes separated on meson by a membranous sheath; cercus divided into ventrad digitate lobe and dorsad wide, truncate lobe; mesal lobe (tenth tergite) darkened distally, irregularly dentated (Fig. 1C). Claspers short, subtriangular, ventral margin straight, apex acute, dorsal margin dark bearing minute setae. Aedeagus shield arcuate, ventral process massive and joined to base of clasper, about midway to apex it becomes bifid and tapers to an acute ventrad curved apex; from ventral aspect (Fig. 1D) apices acute, convergent. Membranous aedeagus bearing internal pair of minute sclerotized processes, best seen from ventral aspect (Fig. 1D).

Holotype male, LODGEPOLE, SEQUOIA NATIONAL PARK, CALIFORNIA, 6,800 feet, 27 August 1969, black light, R. G. and M. C. Malin. Deposited in the Entomology Collection, University of California, Riverside, California.

PSYCHOMYIIDAE

Tinodes gabriella Denning, new species

Members of the genus are cosmopolitan, widespread, and occasionally abundant. This new species represents the tenth North American species. All known species are found only in the western states and adjoining Mexico. This species may be distinguished from other *Tinodes* by the lateral or the ventral aspect of the claspers, by the mesal prong of the clasper, and by the aedeagal sheath. *Tinodes gabriella* is related to *T. provo* Ross.

MALE.—Length 8.5 mm. Wings fuscus, head and thorax darker, appendages similar. Spurs 2-4-4, same color as legs. Genitalia as in Fig. 2. Ninth sternum trianguloid, largely covered by eighth sternum, dorsal corner connected to aedeagal sheath. Apex of ninth tergum terminated in membraneous sheath. Cerci fusiform, extending caudad beyond remainder of genitalia. Clasper basal segment somewhat rectangular, ventral margin slightly shorter than dorsal; from ventral aspect (Fig. 2A) apices blunt, short acute spine present along mesal margin near apex; apical segment with dorsal and ventral margins almost parallel, apex obtuse; from ventral aspect, apices convergent. Mesal blade of clasper curved ventrocaudad, apex truncate, pair of prominent acute spines, subequal in size at base (Fig. 2). Aedeagus encased in a long, slender tubular sheath, curved ventrad and armed with prominent spines (Fig. 2B); aedeagus elongate, apex acuminate (Fig. 2C).

Holotype male, GRAVEYARD CANYON, EAST FORK, SAN GABRIEL RIVER, LOS ANGELES COUNTY, CALIFORNIA, 9 May 1970, J. A. Honey. Type will be deposited in the Entomology Collection, Los Angeles County Museum of Natural History, Los Angeles, California.

Because the distribution of *Tinodes* species is poorly known, the following distributional records are given.

TINODES CONSUETA McLachlan

This ubiquitous species in California is often present in abundance. It is here recorded from Gold Beach, Oregon, 30 June 1967, Kenneth Goeden, and Medford, Oregon, 1 July 1966, L. G. Gentner.

TINODES PROVO Ross and Merkley

The species occurs in Utah, Arizona and California. It is here recorded from Gooding County, Idaho, 10 April, R. L. Newell. In the Aqua Caliente Indian Reservation, Riverside County, California, P. H. Arnaud collected several males and females on 24 and 25 February 1970. At 5000 feet elevation, T. W. Fisher collected a male in Inyo County, California on 9 March 1966; it probably also occurs in Nevada.

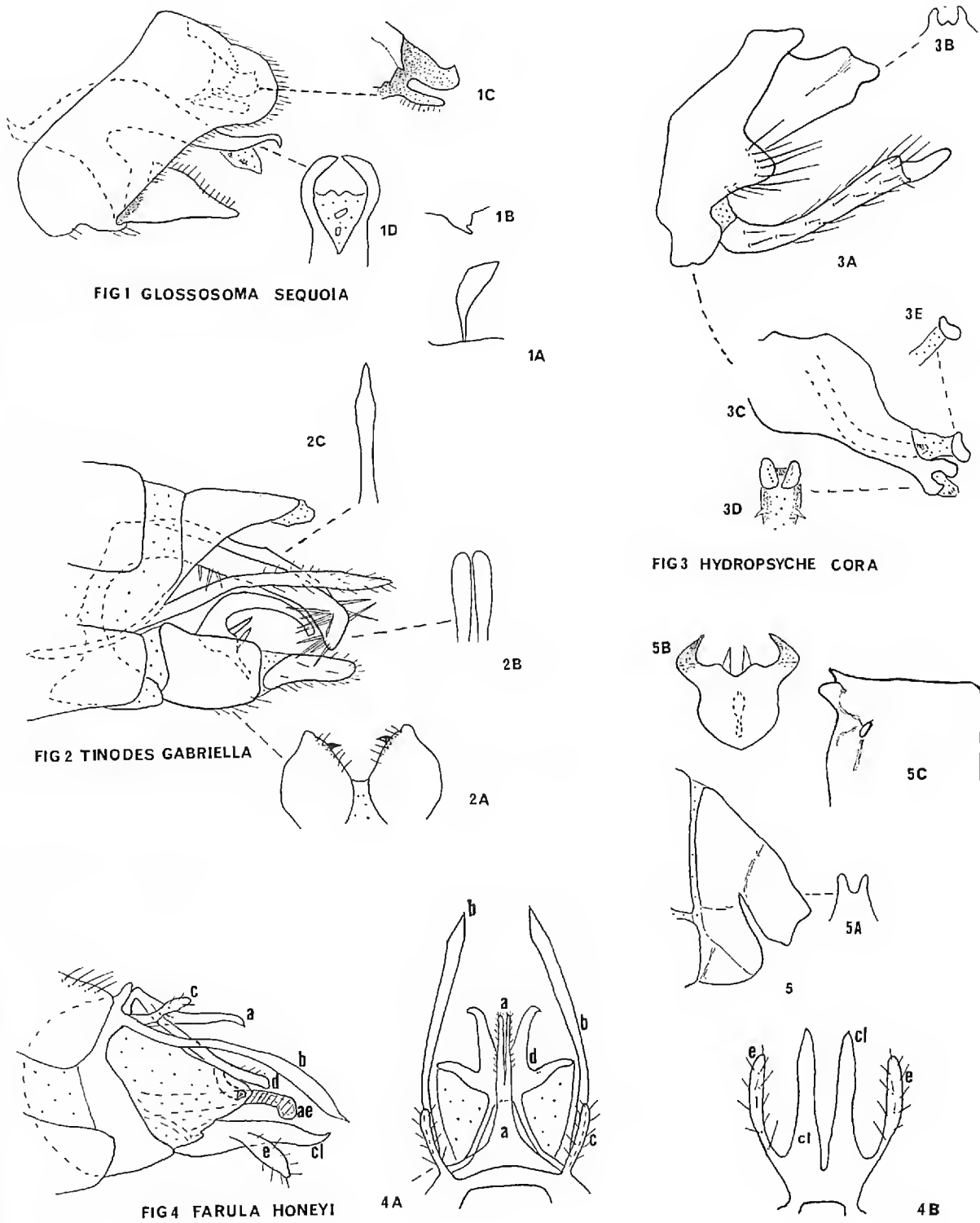


FIG. 1. *Glossosoma sequoia* Denning, male genitalia, lateral view. 1A, fifth sternite lobe, lateral view. 1B, eighth sternite tubercle. 1C, cercus and tenth tergite, lateral view. 1D, aedeagus apex, ventral view. FIG. 2. *Tinodes gabriella* Denning, male genitalia, lateral view. 2A, apices of basal segment of clasper, ventral view. 2B, aedeagus sheath, ventral view. 2C, aedeagus apex. FIG. 3. *Hydropsyche cora* Denning, male genitalia. 3A, lateral view of male genitalia. 3B, tenth tergite apex, dorsal view. 3C, aedeagus lateral view. 3D, apex of aedeagus, dorsal view. 3E, dorsal ovoid plate, lateral view. FIG. 4. *Farula honeyi* Denning, male genitalia, lateral view. 4A, male genitalia, dorsal view. 4B, claspers, ventral view. FIG. 5. *Farula honeyi* Denning, female genitalia, 5A, apex eleventh tergite, dorsal view. 5B, spermatheca ventral view, 5C, fifth sternite, lateral aspect.

TINODES SIGODANA Ross and Merkley

To date collections are available only from Los Angeles County, California. It has recently been collected from June to July, 1970 and 1971 by J. A. Honey in the San Gabriel Mountains, Los Angeles County, California.

TINODES POWELLI Denning

New records from southern California are available. Riverside County: near Palm Desert, 26 June 1970, 23 July 1969, Saul Frommer; Aqua Caliente Indian Reservation, 24 February 1970, P. H. Arnaud; Los Ninas Ranch, Murrieta Road, 18 July 1971, J. A. Honey; San Diego County: Scissors Crossing, 7 October 1971, J. A. Honey; Orange County: Holy Jim Creek, 25 April 1970, J. A. Honey. Utah: Washington County, Leeds Canyon, July 1967, W. J. Hanson. The species is now known to occur from Baja California to Utah.

TINODES SISKIYOU Denning

Described from Jackson County, Oregon, it has now been collected in Wallowa County, Oregon, 1 July 1967, Kenneth Goeden. California records are now available: Mendocino County, 9 March 1968, J. R. Helfer; Sonoma County, 17 June 1972, D. G. Denning, along a heavily shaded shallow cool water creek; Lake County, Big Canyon Creek, June 17 and October 21, 1972, Paul Peterson.

TINODES CASCADIA Denning

Known only from Oregon. A new Oregon locality is: Douglas County, Oregon, 13 miles East Reedsport, collected resting on a wet seepage cliff, 1 June 1966, J. D. Vertrees and Joe Schuh.

TINODES BELISA Denning

Known from Oregon south to Butte, Lake and Sonoma County, California.

HYDROPSYCHIDAE

Hydropsyche cora Denning, new species

This new species is related to *H. venada* Ross. It is easily discernible from other *Hydropsyche* in the configuration of the tenth tergum, the position of the spur associated with the membraneous dorsolateral process of the aedeagus, the dorsal plates and the short, thick peculiar profile of the aedeagus.

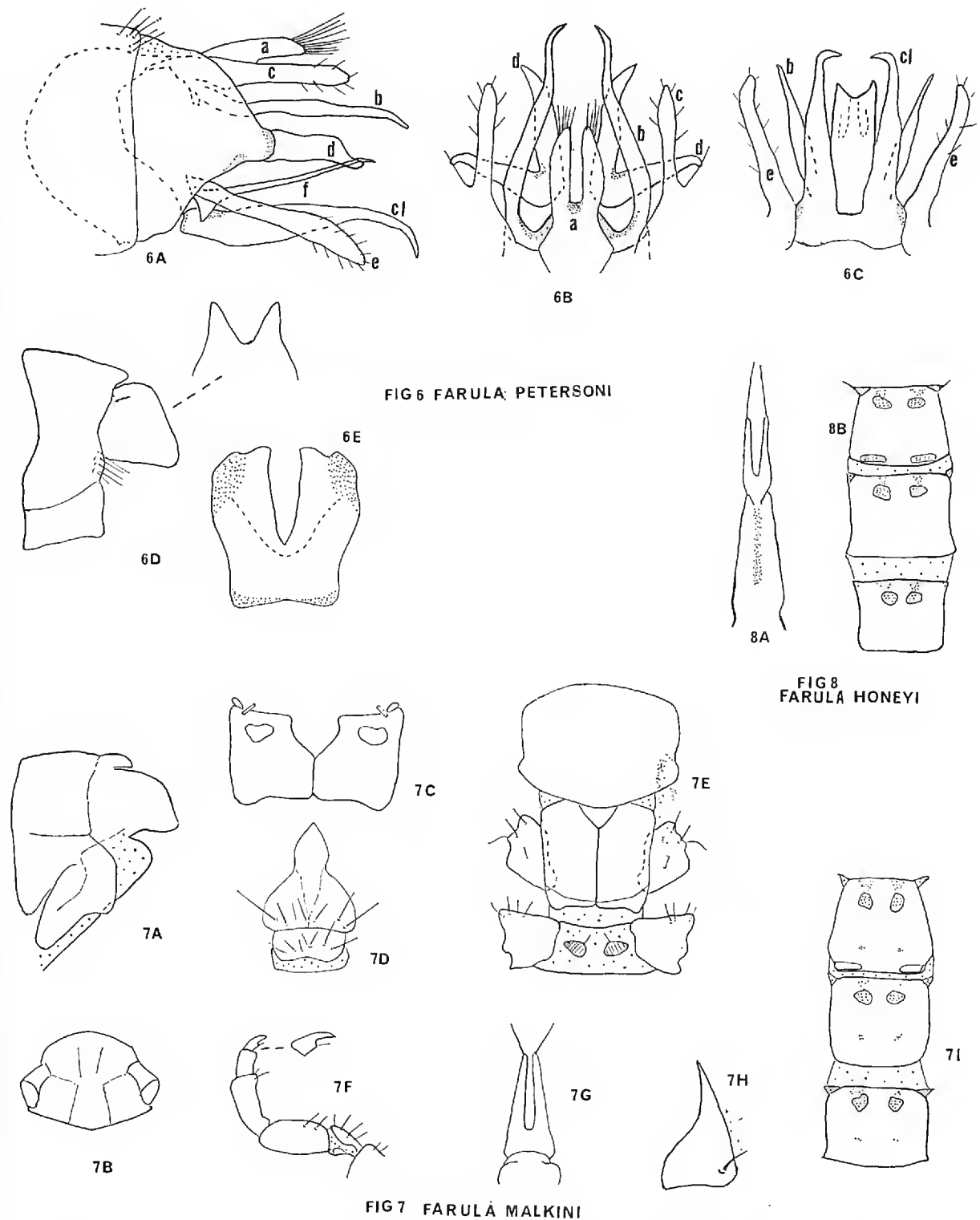


FIG. 6. *Farula petersoni* Denning, male and female genitalia. 6A, lateral view of male genitalia. 6B, dorsal view of male genitalia. 6C, ventral view of claspers. 6D, female genitalia, lateral view. 6E, spermatheca, ventral view. FIG. 7. *Farula malkini* Ross. 7A, female genitalia, lateral view. 7B, spermatheca, ventral view. 7C, head of larva, dorsal view. 7D, larval labrum. 7E, larval prothorax, mesothorax and metathorax, dorsal view. 7F, foreleg of larva. 7G, pupa, apex of abdomen. 7H, pupal mandible. 7I, sixth, seventh, eighth tergite of pupa, showing mesal plates. FIG. 8. *Farula honeyi* Denning, pupa, 8A, apex of abdomen, dorsal view. 8B, abdominal segments, six, seven and eight, dorsal view.

MALE.—Length 7.5 mm. Wings dark gray, head, thorax and antennae dark brown, legs yellowish. Genitalia as in Fig. 3. Ninth segment annular, lateral projection ovate, tergum directed caudad. Tenth tergum with distinct dorsal angulation; from dorsal aspect, Fig. 3B, apex divided into pair of short subacute processes, slightly convergent. Clasper apical segment short, digitate, slightly narrowed from basal segment. Aedeagus, Fig. 3C, with base at right angle to ninth segment, basal half large and irregular, distal portion considerably narrowed; apex divided into dorsal and ventral branches with small membranous area in between bearing minute extrusible spines; dorsomesal membranous area bearing pair of short black acute spines near base (Fig. 3D) and ovoid dorsal plates (Fig. 3E) appear dorsad to apex.

Holotype male, VALLEY FORGE CANYON, SAN GABRIEL MOUNTAINS, LOS ANGELES COUNTY, CALIFORNIA, 26 May 1971, J. A. Honey. Type to be deposited in the Entomology collection, Los Angeles County Museum of Natural History, Exposition Park, Los Angeles, California.

LIMNEPHILIDAE

FARULA Milne

The genus *Farula* is known only from Washington, Oregon and California. There are seven species ascribed to the genus, including the two new species described here. Members of the genus are seldom collected and are rare in collections. Previous to the collection of the new species *F. honeyi*, and *F. petersoni*, all members of the genus were known only from Washington and Oregon. *Farula* species are generally collected in cool high humidity areas from relatively low elevations to 5,000 feet. One new species described here is from southern California and represents a great extension southward of this interesting genus. To be consistent with described species the same lettering system is used as that employed by Ross (1950) in describing the complicated male genitalia.

Farula honeyi Denning, new species

MALE.—Length 6 mm. Wings dark gray, densely setose; head, thorax, femora blackish, antennae and legs brownish, covered with dense dark setae. Maxillary palpi porrect, slightly shorter than labial palpi, third segment slightly longer than second, light yellowish. Head between antennae and palpi with thick yellowish setae. Genitalia as in Fig. 4. Dorsal lobe of ninth tergite, process "a", slender and undulating in lateral aspect, distal half bifurcated, slender, subacute (Fig. 4A) entire structure slightly sclerotized, difficult to discern. Process "b", (probable ventral lobe of ninth tergite), long, slender, arcuate from lateral aspect, apex flattened, acute; from dorsal view (Fig. 4A) distal portion widened and convergent. Cercus "c", slender, digitate, directed dorsocaudad. Process "d", (probable tenth tergite), directed ventrocaudad, lateral branch barely discernible from lateral view; from dorsal view (Fig. 4A) bifid distally, apices divergent, mesolateral arm projected laterad, short and stocky; transparent membranous sheath extends

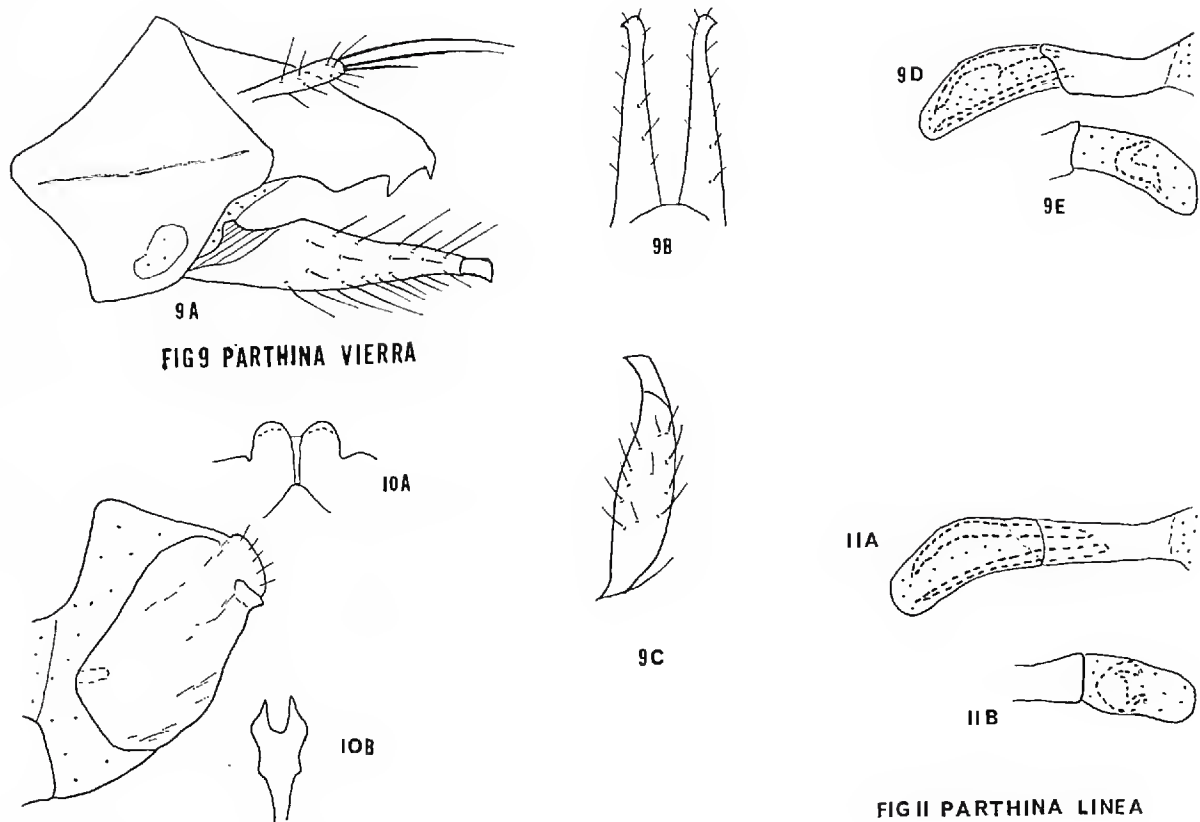


FIG 9 PARTHINA VIERRA

FIG 10 PARTHINA VIERRA

FIG 11 PARTHINA LINEA

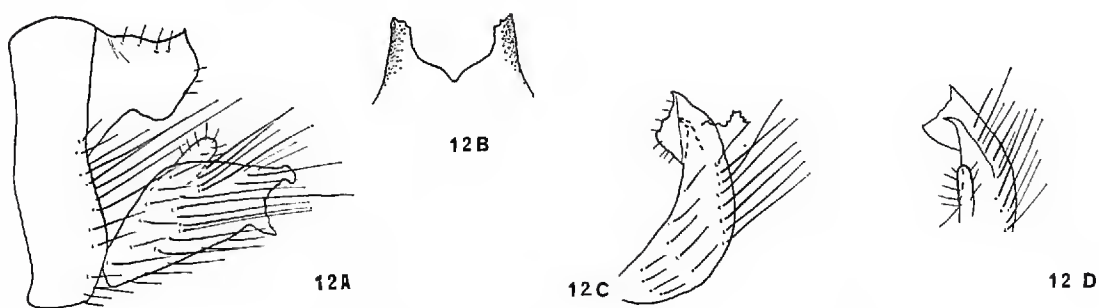


FIG 12 LEPIDOSTOMA LACINATUM

FIG. 9. *Parthina vierra* Denning, male genitalia. 9A, male genitalia, lateral view. 9B, tenth tergite, dorsal view. 9C, clasper, ventral view. 9D, aedeagus, right lateral view showing internal dorsal rod, and the slender ventral rod. 9E, aedeagus, left lateral view, showing internal bifid sclerotized structure. FIG. 10, female genitalia, lateral view. 10A, eleventh tergum, dorsal view. 10B, spermatheca, ventral view. FIG. 11. *Parthina linea* Denning. 11A, aedeagus, right lateral view, showing the dorsal and ventral internal rods. 11B, left lateral view, bifid internal structure. FIG. 12. *Lepidostoma lacinatum* Flint. 12A, male genitalia, lateral aspect. 12B, dorsal view, tenth tergite. 12C, clasper, caudoventral view. 12D, clasper apex, mesodorsal view.

from apex of lateral arm to cercus and margin of ninth segment. Claspers, "cl", heavily sclerotized, tapered to dorsad curved acute apex; from ventral aspect (Fig. 4B) claspers widely separated, acute, directed caudad; process "e" originates near base, best discernible from ventral aspect, digitate, lightly sclerotized, setose, homol-

ogy unknown. Aedeagus "ae", semimembraneous, difficult to discern except from lateral aspect (Fig. 4) slender throughout, apex abruptly curved ventrad.

FEMALE.—Length 6 mm. Similar to male in general structure and color. Tenth tergite narrow and elongate, division between tenth and eleventh tergite obscure (Fig. 5) eleventh tergite declivent, apex nearly truncate, from dorsal aspect (Fig. 5A) bifid. Spermatheca (Fig. 5B) occupying most of ninth and tenth sternites, mesal aperture long, narrow. Fifth sternite cephalid corner developed into obtuse process and invaginated small clear, elongate area (Fig. 5C).

PUPA.—Length 5 mm. General structure similar to that of *F. malkini* (Fig. 8A). Apex of mandibles acute, slender, no serrations. As in *F. malkini* labrum bears six long black setae. Apex of abdomen and mesal plates of tergites six, seven and eight, almost identical to *F. malkini* (Fig. 8B).

Holotype male, SAN GABRIEL MOUNTAINS, VALLEY FORGE CANYON, LOS ANGELES COUNTY, CALIFORNIA, 26 May 1971, J. A. Honey. Allotype, same data as for holotype. Paratypes, 13 males, 8 females, same data as for holotype; 1 male, Angeles Crest Highway, San Gabriel Mountains, Los Angeles County, California, 2 June 1970, J. A. Honey. Holotype, allotype and 2 male and 2 female paratypes deposited in Entomology Collection, Los Angeles County Museum of Natural History, Los Angeles, California.

I take pleasure in naming this *Farula* in honor of the collector, J. A. Honey, who has collected many very interesting Trichoptera. The collection site consisted of "a very small trickle of water running down almost verticle rocks" at an altitude of 4,800 feet. Valley Forge Canyon is "a small, very steep canyon," the stream forms "many small falls and pools," in the summer "it is reduced to a trickle."

***Farula petersoni* Denning, new species**

This species is related to *F. malkini*, but in many details of the male genitalia it differs greatly from that species.

MALE.—Length 6 mm. Wings gray, pubescence sparse. Basal segment of antenna whitish except for mesal brown stripe entire length. Labium also whitish. Maxillary palpi porrect, whitish, pubescence dark and quite heavy. Pronotum with two pairs of semicircular white areas; mesoscutellum whitish, remainder black. Genitalia as in Fig. 6. Dorsal lobe of ninth tergum, process "a" (Fig. 6A) lightly sclerotized, digitate, apex oblique and bearing dense fringe of long brownish setae in lateral aspect; from dorsal aspect (Fig. 6B) bifurcated from base, each lateral lobe slender, directed caudad. Process "b", sinuate in lateral aspect (Fig. 6A) acuminate, apex acute and curved ventrad; viewed dorsally rod-like structures acute, curved laterad then mesad, gradually convergent (Fig. 6B). Cercus "c", long, slender, about same width throughout, setae sparse. Process "d", stout, heavily sclerotized, directed caudad beyond cerci, dark subacute apex curved laterad; basolateral branch barely discernible; from dorsal aspect (Fig. 6B) basal branch directed caudolaterad, apex attached to lightly sclerotized and pigmented sheath

dorsad to cercus and ninth tergum, apices of mesal branches acute and divergent. Claspers "cl", considerably narrowed distally, apex acute, curved sharply ventrad; from ventral aspect (Fig. 6C) directed caudad, apices acute, curved strongly mesad; process "e" originates near base, digitate, slender, apex subacute, directed caudoventrad; filamentous branch "f" (Fig. 6A) arise from base and extend caudad slightly beyond process "d". Aedeagal shield lightly sclerotized, trough-like, apical emargination rounded from ventral aspect (Fig. 6C).

FEMALE.—Practically identical to male in size, wing pubescence and general coloration. Genitalia as in Fig. 6D. Tenth segment annular, division between it and eleventh tergum obscure. Eleventh tergum declivant, ventrocaudal apex rounded, apex bifid from dorsal aspect. Spermatheca (Fig. 6E) occupy portion of ninth and most of tenth sternites; mesal aperture wide, elongate.

Holotype male, UNNAMED CREEK ONE MILE NW TRINIDAD, HUMBOLDT COUNTY, CALIFORNIA, 1 May 1972, elevation 50 feet, Paul A. Peterson. Allotype female, same data as for holotype, except 3 June 1971. Paratypes 3 males, 2 females, same data as for allotype.

This species is named in honor of the collector, Paul A. Peterson, who collected the species from a small creek "about 3 feet wide and 1 foot deep, with a rocky, moss-covered bottom and scattered gravel-filled pools." "The creek ends abruptly in a 30 foot waterfall emptying into the Pacific Ocean."

FARULA RAINIERI Milne

Until recently known from 1 male collected at Mt. Rainier, Washington. Schmid, 1968 recorded the species from Chinook Pass, Washington, Skagit County, Washington and Marion County, Oregon. On 15 June 1969, R. W. Baumann collected 1 male at a creek at Christmas Falls, Mt. Rainier, Washington.

FARULA MALKINI Ross

Previously known from 2 males collected in Benton County, Oregon, it was recently recorded in large numbers from Oak Creek in Benton County by Anderson and Wold. The species was collected in emergence traps in April and May. Here recorded from Douglas County, Oregon, 18 miles east of Reedsport, Loon Creek Road, 27 May 1964, 3 males, 2 females, and on 1 June 1966, 1 male, 2 females, J. D. Vertrees and Joe Schuh. Adults, larval and pupal cases collected from a wet seepage cliff. Cases collected when few mature larvae or pupae were present, the majority of cases contained dead and disintegrating larvae and pupae.

FEMALE.—Similar to male in color and size. Genitalia as in Fig. 7A. From lateral aspect tenth segment annular; eleventh tergum obtuse, declivent; from

dorsal aspect, lateral apices widely cleft, subacute; bursa copulatrix triangular, mesal aperture narrow, long (Fig. 7B).

LARVA.—Head uniformly dark brown except for irregular cleared eye area, near apical corner inconspicuous slender antenna (Fig. 7C) epicranial suture distinct, from dorsal aspect (Fig. 7D); labrum with row of several short setae. Prothorax with no trace of a transverse furrow; dark brown, completely and heavily sclerotized, distinct mesal fracture; mesothorax completely sclerotized, light brown, distinct mesal fracture, apical margin with mesal emargination; metathorax with pair of brown sclerotized irregular-shaped lateral plates and pair of oval semi-membraneous grayish areas bearing three minute setae (Fig. 7E). Forelegs (Fig. 7F) with femora widened, apical margin short, only slightly longer than tibia. Based on one partially intact larva, remainder too decomposed for description.

PUPA.—Apex of abdomen (Fig. 7G) with long, finger-like lobes, narrowed distally, largely devoid of setae. Mandibles acute (Fig. 7H) no serrations; labrum with group of six long dark setae. Sixth, seventh and eighth tergites with mesal plates (Fig. 7I); sixth tergite with pair of irregular oval plates near apical margin and pair of narrow elongate plates at posterior corner; seventh and eighth tergites with pair of irregular oval plates near anterior margin, each bearing several minute hooks; abdomen without lateral fringe of hair.

CASE.—Case of mature larva and pupa 5–6 mm long, cylindrical and slightly curved, tapering gradually from 0.5 mm to almost 1 mm in diameter. Constructed of minute sand grains, all similar in size and cemented together to form smooth exterior.

ODONTOCERIDAE

Parthina vierra Denning, new species

The genus has been represented by a single species, *P. linnae*. This second species may be recognized by the configuration of the tenth tergite, the short apical segment of the clasper and the internal processes of the aedeagus.

MALE.—Length 7.5 mm. General color dark brown, wings densely setose, reflexed fold of the subcostal cell of forewing filled with intermixture of dark and light colored scales; head and thorax dark brown, mesoscutellum whitish, setose sparse; maxillary and labial palpi light brown, setose; tibial spurs densely covered with short brown setae. Genitalia as in Fig. 9. Ninth segment widest laterally with obtuse cephalad and short truncate distal projections, dark line extends through segment, tergum considerably narrowed, distinct semicircular clear area near sternum (Fig. 9A). Tenth tergite composed of pair of lateral convex plates, distal corner deeply emarginate, resultant acute prongs directed ventrad; from dorsal aspect (Fig. 9B) lateral plates widely separated, apex obliquely truncate, slightly divergent. Cerci digitate, bearing several very long setae. Clasper basal segment long, cylindrical, gradually tapered distally, basal portion characteristically darkened; apical segment short, truncate (Fig. 9A); from ventral aspect (Fig. 9C) apical segment acute, curved mesad. Basal portion aedeagus sclerotized, distal portion semimembraneous; from left lateral aspect (Fig. 9E) internal bifid, light brown sclerotized structure discernible; from right lateral aspect (Fig. 9D) internal dorsal rod present, distally acuminate and sharply curved ventrad, near base acute

ventral angulation present, located ventrad long, slender, acuminate rod reaches almost to apex; aedeagus slightly longer than combined ninth segment and claspers.

FEMALE.—Genitalia as in Fig. 10. General appearance similar to male except absence of scales on forewings. Tenth segment large, oval, light brown sclerotized; eleventh tergum lightly sclerotized, from dorsal aspect (Fig. 10A) narrowly separated on meson, apex rounded; bursa copulatrix (Fig. 10B) long and narrow.

Holotype male, UVAS CREEK, UVAS CANYON, SANTA CLARA COUNTY, CALIFORNIA, 3 July 1971, D. G. Denning; allotype, same data as for holotype; paratypes, 4 males, 3 females, same data as for holotype.

PARTHINA LINEA Denning

In the original description the internal structures of the aedeagus were not figured. When viewed from the left lateral aspect, Fig. 11B, the internal structure divided into a dorsal process widened distally, and an acute short ventral process, from right lateral aspect, Fig. 11A, dorsal rod acuminate and curved slightly ventrad, ventral rod long, slender, acuminate.

Parthina linea was described from specimens collected in Tuolumne County, California, and from near McMinnville, Oregon. Additional records are: 27 males, 6 females west of Selma, Josephine County, Oregon, 6 May 1964, Joe Schuh; 10 males, 1 female Macalester Wash near Martinez, Yuma County, Arizona, 30 March 1961, C. A. Toschi Tauber; this water is backed up from the Colorado River and contains numerous cattails and algae; 1 male Santa Clara County, California, 1 June 1960, S. D. Smith.

LEPIDOSTOMATIDAE

LEPIDOSTOMA LACINATUM Flint

This species has not been recorded since it was described from Durango and Sinaloa, Mexico by Flint, 1967. The collection in Arizona represents an extension northward of about 700 miles. One male collected at Miller Canyon, Huachuca Mts., Santa Cruz County, Arizona, 17 August 1971, 7,000 feet, J. A. Honey.

The Arizona specimen suggests the species may be quite variable (Fig. 12). Major differences are: the short, robust tenth tergite, apices truncate, not distally narrowed (Fig. 12A) from dorsal aspect (Fig. 12B) apices widely separated; aedeagal prongs only slightly convergent; apex of apicodorsal lobe of clasper curved ventrad, lateral surface with a dense mat of long yellowish setae which obscures details of the structure, from caudoventral aspect (Fig. 12C) apex acute; from meso-

dorsal aspect (Fig. 12D) the acute hooked ventral arm of the mesodorsal process reaches almost to margin.

LITERATURE CITED

- ANDERSON, N. H. AND J. L. WOLD. 1972. Emergence Trap Collections of Trichoptera from an Oregon Stream. *Can. Entomol.*, 104: 189-201.
- FLINT, O. S. 1967. Studies of Neotropical Caddis Flies, VI: on a collection from northwestern Mexico. *Proc. Entomol. Soc. Wash.*, 69: 162-176.
- ROSS, N. H. 1950. Synoptic notes on Some Nearctic Limnephilid Caddis-flies (Trichoptera, Limnephilidae). *Amer. Midland Natur.*, 43: 410-429.
- SCHMID, F. 1968. Quelques Trichopteres Neartiques nouveaux ou peu connus. *Natur. Can.*, 95: 673-698.

BOOK REVIEW

THE MOTHS OF AMERICA NORTH OF MEXICO. FASCICLE 21, SPHINGOIDEA. Ronald W. Hodges. E. W. Classey Ltd. and R. B. D. Publications, Inc. 158 p., 14 color plates, 19 figs., xii. 1971. \$24 (subscription price \$19.60). North American Distributor: Entomological Reprint Specialists.

This is the first to be published in a projected series of 41 Fascicles treating "The Moths of America North of Mexico." The concept of covering the more than 10,000 species with color illustrations of all species and their major color forms is truly a monumental one. The present fascicle on the Sphingoidea provides an excellent advertisement for the high quality of the series. The heavy paper, large clear print, beautifully reproduced life size color illustrations, and excellent line drawings are a credit to all involved with the production of this fascicle. A brief history of the project with photos of those involved appears in an introductory section.

Keys to 40 genera and 115 species of adults and partial keys to genera based on pupae and mature larvae are presented. Species treatments vary in completeness. They include synonymies, adult and larval diagnoses, geographic and seasonal distributions, food plants and habits. Intraspecific variation is discussed and often illustrated, but subspecies are not treated as such. Text figures of genitalia are provided for representatives of most genera. A few name changes are apparent even to the non-lepidopterist. *Celerio* and *Protoparce* are treated as synonyms of *Hyles* and *Manduca* respectively.

The 14 plates containing 199 color photos are followed by two plates of excellent, clearly labelled structural drawings by the author's wife. The fascicle concludes with indices to animal and to plant names.

The cost of the series seems a bit high for the average entomologist, but the quality of the publication and the impressive color plates make it a worthwhile investment for dedicated lepidopterists and a mandatory reference for all institutions.—ROBBIN W. THORP, *University of California, Davis, 95616.*

The Behavior of *Microbembex nigrifrons*

(Hymenoptera: Sphecidae)

JOHN ALCOCK AND ALLEN F. RYAN

*Department of Zoology, Arizona State University, Tempe, 85281, and
Departments of Psychology, Physiology, & Biophysics, University of Washington,
Seattle, 98195*

The behavior of only a few species of *Microbembex* has been reported in any detail (Evans, 1966, for *M. monodonta* (Say); Goodman, 1970, for *M. californica* Bohart). This paper describes the behavior of a previously unstudied member of the genus, *M. nigrifrons* (Provancher). Over two summers (1971, 1972) we made a series of observations on this species in central Washington. The study site was located approximately five miles south of Interstate 10 on Dodson Road within ten miles of Royal City. A series of low dunes scattered through this area are inhabited by *M. nigrifrons* and other bembicine wasps. The dunes rise out of a flat plain covered with sage and other desert scrub brush with buckwheat (*Eriogonum* sp.) common on the fringes and crests of some dunes.

NESTING BEHAVIOR.—This species of *Microbembex* is extremely similar behaviorally to *M. monodonta*, *M. californica*, and all the South American species studied by Evans (personal communication). It nests primarily on the lower fringes of sand dunes and sand banks often burrowing into a slope. Upon completion of a burrow, a task that may require two to three hours early in the season (June), the female performs an initial closure similar to that described for *M. monodonta* by Evans (1966: 370). The wasp walks quickly away from the entrance kicking sand back toward the burrow. After going out 15–25 cm, it then returns and repeats the process in another direction over and over again until the nest is surrounded by a series of radiating lines. The burrow often, but not always, descends at a shallow angle for about one-half its length and then drops much more steeply before levelling off just before the cell (Fig. 1). All nests excavated were single celled.

The egg is laid upright in a vertical position in the empty cell. (One nest held an egg and one small dead beetle.) Provisioning females apparently select any dead arthropod available: ARACHNIDA: Scorpionida 1 (the tail), Araneida 5; INSECTA: Ephemeroptera 3, Orthoptera 15, Hemiptera 8, Neuroptera 1, Trichoptera 1, Lepidoptera 12 (adult and larval forms), Diptera 24, Hymenoptera 15, Coleoptera 31

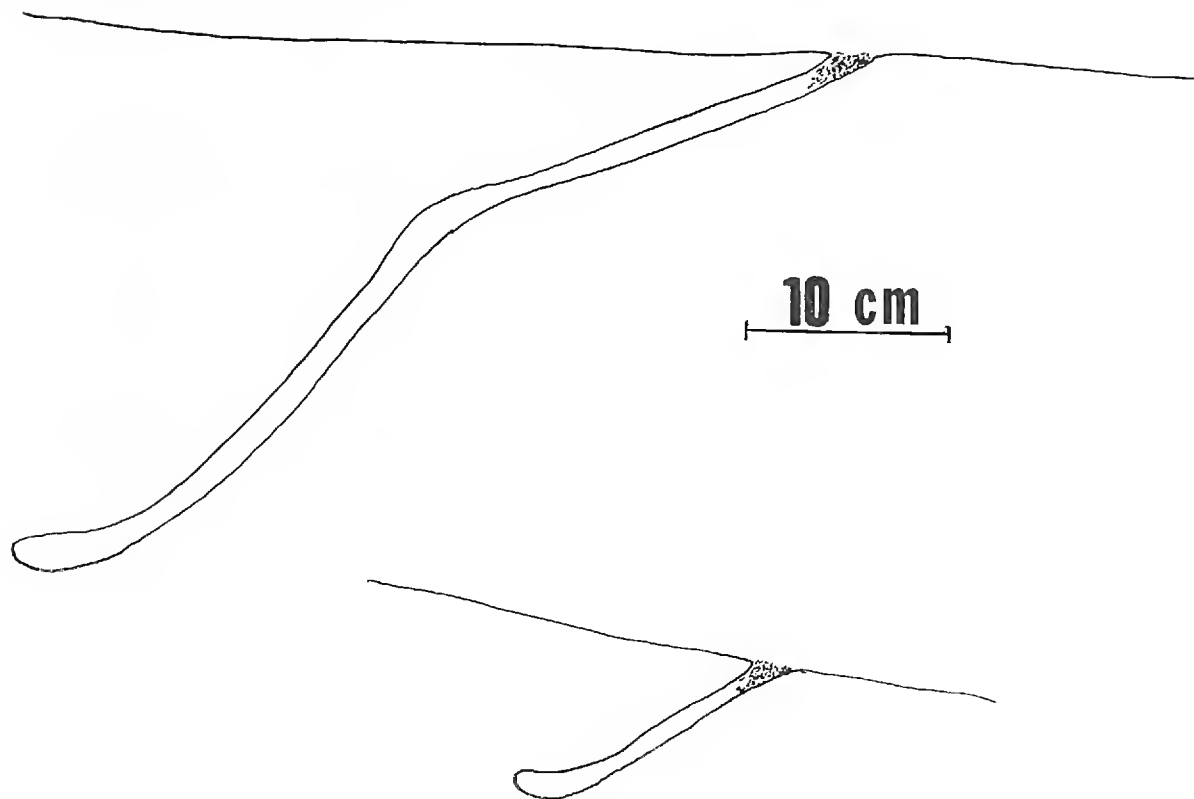


FIG. 1. A diagram of two nests of *M. nigrifrons* illustrating the variation in length and depth as well as nest design that existed at the Dodson Rd. site.

(adult and larval forms). In addition a few females were seen hovering over and then touching small brown seeds and other bits of dried vegetable material perhaps inspecting them as possible prey items.

Three females were observed shortly after they had taken a food item. Two clung upside down to the underside of a branch in the dunes rearranging the prey prior to flying back to the nest. The other was oriented vertically head down on a stick. Females returning to the nest were harassed by other members of their species and one successful prey stealing was observed. The average interval ($N = 8$) between provisioning trips to the nest was 21 minutes (range = 7–44). In every respect the behavior of *M. nigrifrons* is highly similar, if not identical, to that of *M. monodonta*.

NEST DIMENSIONS AND SAND MOISTURE.—Evans (1966) noted considerable variation in cell depth and burrow length both at the same site and between nesting locations. He demonstrated that part of the differences between burrows was related to the size differences between females. Moreover, Evans speculated that variation between locations could be due to differences in the moisture content of the sand noting that the deepest nests were found in very dry Kansas dunes.

Because preliminary excavations of some nests in mid 1971 revealed exceptionally long and deep burrows this aspect of nesting behavior

TABLE 1. The relation between the nest dimensions of *M. nigrifrons* and the depth of moist sand in the dunes.

	10 June	12 July	12 August 1972	14 Sept. 1971
Average depth of moist sand (cm below surface)	5	11	17.5	5
Nests excavated	12	12	10	10
Average burrow length (cm) ¹	28.3	31.4	48.5	18.7
Range	(15-63)	(26-40)	(42-57)	(14-35)
Average cell depth (cm) ²	13.4	18.9	31.8	14.0
Range	(11-23)	(14-23)	(25-38)	(9-20)
Average distance between moisture line and cell (cm) ³	10.3	8.1	14.3	9.0

¹ Correlation of burrow length with average depth of moist sand, $r = .76$, $P < .01$.

² Correlation of cell depth with average depth of moist sand, $r = .54$, $P < .01$.

³ F test of mean depths of cells below moisture line, $F_{(3,40)} = 16.8$, $P < .01$.

was chosen for more study. On four occasions (14 September 1971, 10 June, 12 July and 12 August 1972) a sample of 10-12 nests was excavated. In the Dodson Road dune area the moisture level in the dunes was very clear cut; extremely dry loose sand gave way to moist compact sand anywhere between 3.5-20 cm beneath the surface depending on the time of year. Table 1 presents data on the correlation between average depth of moist sand and the dimensions of the nests. It is abundantly clear that the lower the moisture level, the deeper and longer the burrows.

The adaptive significance of this behavior is not obscure. It is to the wasp's advantage to locate its cell in an area where the egg and larva will not desiccate prior to formation of a cocoon. This response does indicate a degree of behavioral flexibility with wasps in this population capable of constructing a burrow anywhere from 14-63 cm long depending on environmental conditions. But even this variation can be readily achieved if the wasp is simply programmed to dig a nest with the cell about 10 cm beneath the moisture line (approximately 80% of the sample had cells 7-15 cm below the line). However, the matter is somewhat more complex than this. Wasps building nests when the moisture level was very low placed their cells significantly deeper below the line than those nesting when moist sand was closer to the surface of the dunes (Table 1).

ORIENTATION TO THE NEST.—Evans (1966) remarks that *M. mono-*

donta exhibits an astonishing ability to locate its nest entrance despite great disturbance to the surrounding terrain. He describes experiments by himself and others in which landmarks close to and far from the nest were moved without affecting the orientation of the wasp in the slightest.

We report here a very simple experiment on the homing ability of *M. nigrifrons*. It was apparent from casual observation that females had no difficulty finding their nest although the sand over and around the entrance might be very much disturbed by our activities. To test landmark learning by this species a ring of whitish stones 2–3 cm in diameter were placed in a circle about 15 cm from a nest entrance on 9 August 1972. In addition, a twig 8 cm long was placed inside the ring. The female was digging the nest when this was done.

On 12 August an observer returned to the site to find that there were now two females nesting inside the ring. The stones and twig were moved 25 cm to one side. A small grey pebble was placed where the twig had been to mark the location of the burrows for the benefit of the observer. The depressions left by the small stones were covered with fine sand.

One female returned with prey from her first provisioning trip after displacement of the landmarks and flew directly to the displaced ring. There she began to dig at a spot within the ring that corresponded to the site where the entrance would have been had the rocks not been moved. After 10 minutes of alternately digging and flying up, the female left the ring and flew to the true nest entrance. After digging there only briefly, she returned to the displaced ring, dug for a short time, flew back to the true nest site, opened the burrow and entered. Upon leaving the nest the wasp performed an elaborate and prolonged closure similar to an "initial closure." Five minutes later, she returned with another food item. The wasp flew directly to the displaced ring and dug there briefly before flying to the actual nest which she opened and entered. Nest closure was performed normally. On her third provisioning trip, the female went directly to the nest entrance and entered the burrow. Nest closure was normal.

The second female, returning from her first provisioning trip following displacement of the landmarks, went straight to the spot in the displaced ring where her entrance would have been had the stones not been moved. After about 5 minutes of digging, she flew to her true burrow and began work there. Like the other wasp, she returned to the ring and made several trips back and forth before finally opening the burrow and entering. Nest closure was performed normally.

It seems clear that *M. nigrifrons* will use landmarks close to the nest to locate the entrance. When these cues are very conspicuous it is possible to disorient the wasp by moving them. However, the effect is only temporary, unlike the permanent inability of *Philanthus triangulum* L. to find its nest when a ring of pine cones was displaced some distance from the entrance (Tinbergen, 1951). It may be that *M. nigrifrons* learns a variety of cues and can rely on alternate landmarks if major ones are removed or displaced.

The fact that the first female appeared to be more disoriented than the second one (digging for a longer period of time at the false nest site and performing an elaborate closure once the real nest had been found) is interesting. It seems probable that the second wasp had built her nest after the first one and therefore may have been less accustomed to and dependent upon the ring of stones as orientation guides. Much more work is necessary on this aspect of *Microbembex* behavior.

ACKNOWLEDGMENTS

This study was partly supported by National Science Foundation Grant GB-28714X. We thank Dr. H. E. Evans for his advice and Dr. R. M. Bohart for his kindness in identifying the wasp for us.

LITERATURE CITED

- EVANS, H. E. 1966. The comparative ethology and evolution of the sand wasps. Harvard Univ. Press, Cambridge, 526 pp.
- GOODMAN, W. G. 1970. Observations on the behavior and biology of *Microbembex californica* Bohart (Hymenoptera: Sphecidae). Pan-Pac. Entomol., 46: 207-209.
- TINBERGEN, N. 1951. The study of instinct. Oxford Univ. Press, Oxford, 228 pp.

RECENT LITERATURE

CERAMBYCIDAE OF NORTH AMERICA. PART VI, NO. 1. TAXONOMY AND CLASSIFICATION OF THE SUBFAMILY LEPTURINAE. E. Gorton Linsley and John A. Chemsak. University of California Publications in Entomology. Volume 69. University of California Press, Berkeley. 138 p., 41 figs., 2 plates. 1972. \$5.50.

This volume is part of a continuing series toward a monograph of the long-horned beetles of America north of Mexico. It treats the tribes Desmocerini, Necydalini, and the 22 genera of Lepturini with lateral spines or tubercles on the pronotum and/or with entire eyes. Those Lepturini without pronotal tubercles and emarginate eyes will be treated subsequently in a second number of Part VI. Exquisite half-tone illustrations by Celeste Greene and distribution maps are provided for many representative species.—ROBBIN W. THORP, *University of California, Davis, 95616*

A New Subspecies of *Plebejus acmon*

(Lepidoptera: Lycaenidae)

CARLL GOODPASTURE

Department of Entomology, University of California, Davis 95616

Plebejus acmon (Westwood & Hewitson) and *Plebejus lupini* (Boisduval) are closely related, variable species characterized by conspicuous sexual dimorphism, a well marked orange or pink hind wing band, and use of *Eriogonum* as foodplant. A recent biosystematic study of this complex and of an additional related species, *P. neurona* (Skinner), suggests that biological relationships are unusually complex. Morphological intergradation, apparent character displacement, and wing pigmentation polymorphism complicate analysis of variation. Discussions of regional morphological and biological differentiation within and intergradation between *P. acmon* group members is presented elsewhere (Goodpasture, 1973a).

The purpose of the present paper is to describe a new entity of the *P. acmon*-*P. lupini* species complex from the southern Rocky Mountain region. The new entity is considered conspecific with *P. acmon* because of morphological intergradation with this species. Recognition of this entity as a subspecies clarifies patterns of variation in this complex.

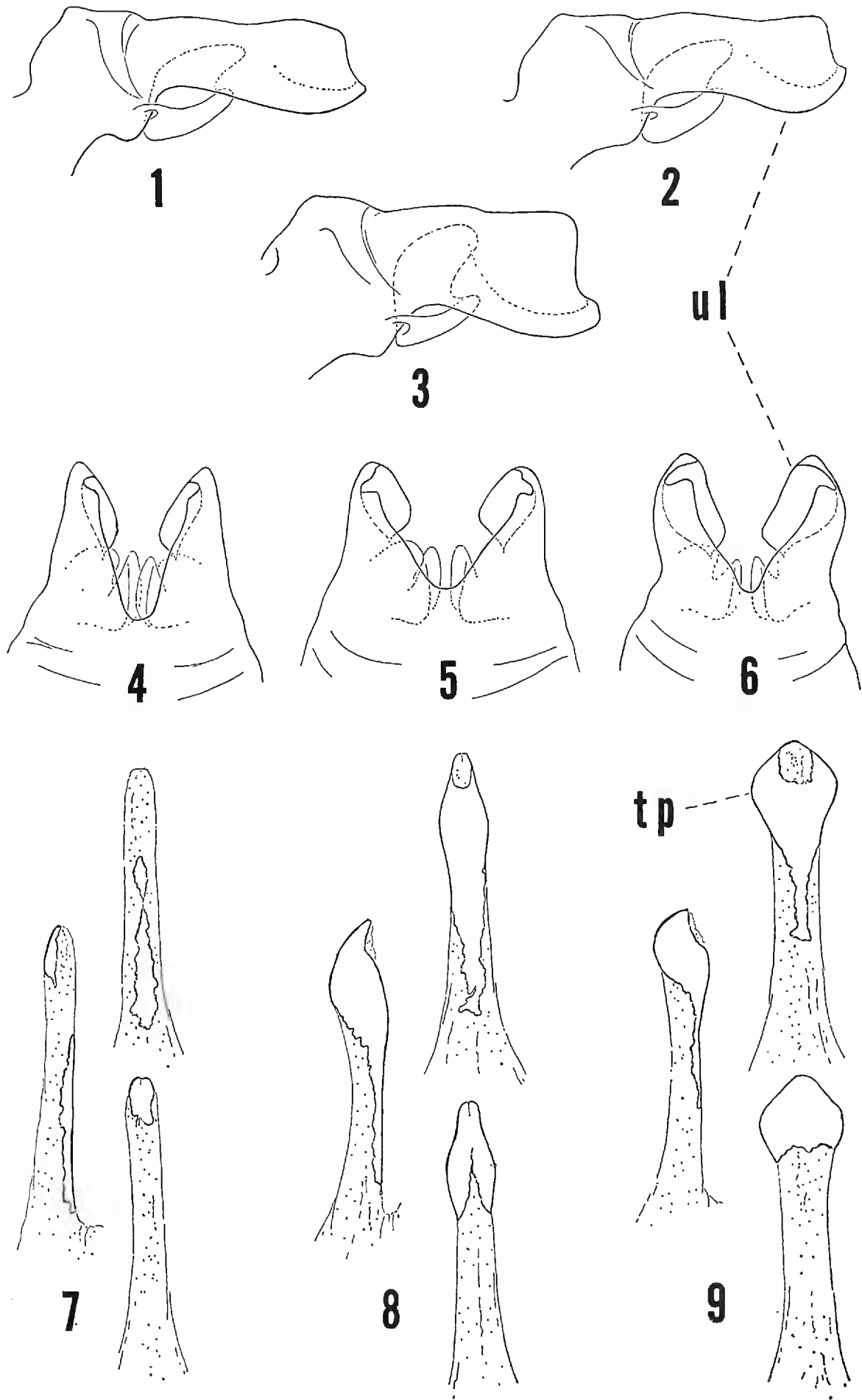
***Plebejus acmon texanus* Goodpasture, new subspecies**

MALE.—Forewing length (straight-line distance from base of costa to apex of M_1) of type series $\bar{x} = 11.2 \text{ mm} \pm .45 \text{ mm}^1$ ($N = 13$); Type 12.3 mm. *Dorsal wing surface* (Fig. 12).—General wing color created by more or less continuous sheet of iridescent cyanic scales overlying dark scale subsurface. Overlay color purple of low saturation and brilliance. Approximate hue² of iridescence of cyanic overlay Purple-Blue Purple. Black band at apical margin of primary moderately broad with few black scales extending basally along veins. Transition of black marginal band on primaries with cyanic overlay scales gradual. Numerous dark scales scattered over wing surface. Indistinct row of dark scales present at apex of discal cell. Distal insulae of secondaries well separated from terminal line. Submarginal band on secondaries orange, appearing rose when viewed from certain angles, bordered basally by few dark scales. *Ventral wing surface.*—Dark gray ground color; black spots encircled by distinct ring of white scales; submarginal orange band broad. *Genitalia.*—Uncus lobes as seen in dorsal view blunt, not strongly spatulate; in lateral view, small and quadrate as in Figs. 2 and 5.

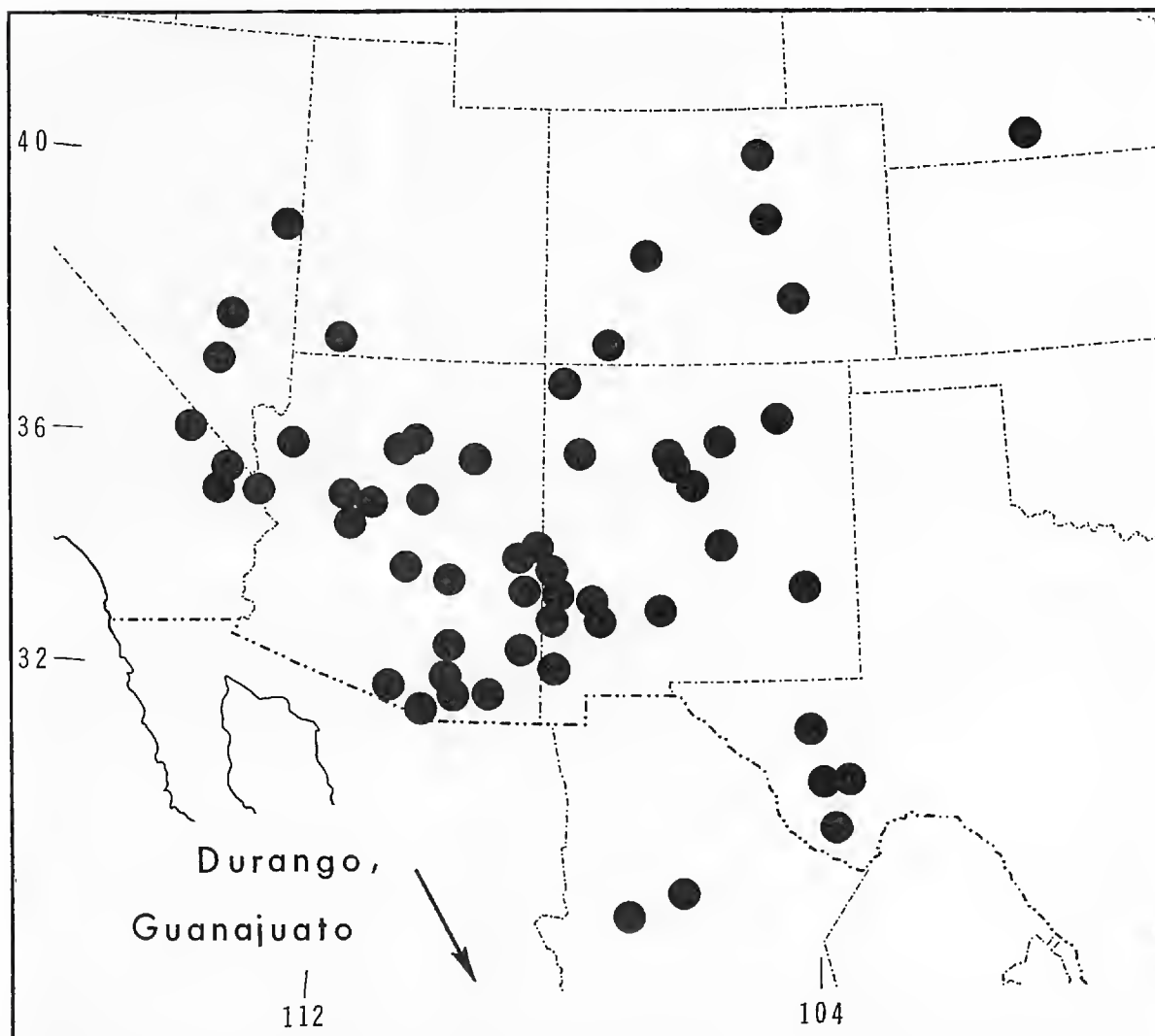
FEMALE.—Forewing length of type series $\bar{x} = 11.0 \text{ mm} \pm .61 \text{ mm}$ ($N = 14$);

¹ Standard deviation.

² Color terminology follows the Munsell book of color (Anonymous, 1942. Munsell Color Co., Inc., Baltimore, Md., 145 pp.).



FIGS. 1-9. Genitalia of species of the *Plebejus acmon* complex: Uncus of male, lateral view (1-3) dorsal view (4-6). Sterigma of female (7-9), dorsal (upper),



Map 1. Distribution of *Plebejus acmon texanus*.

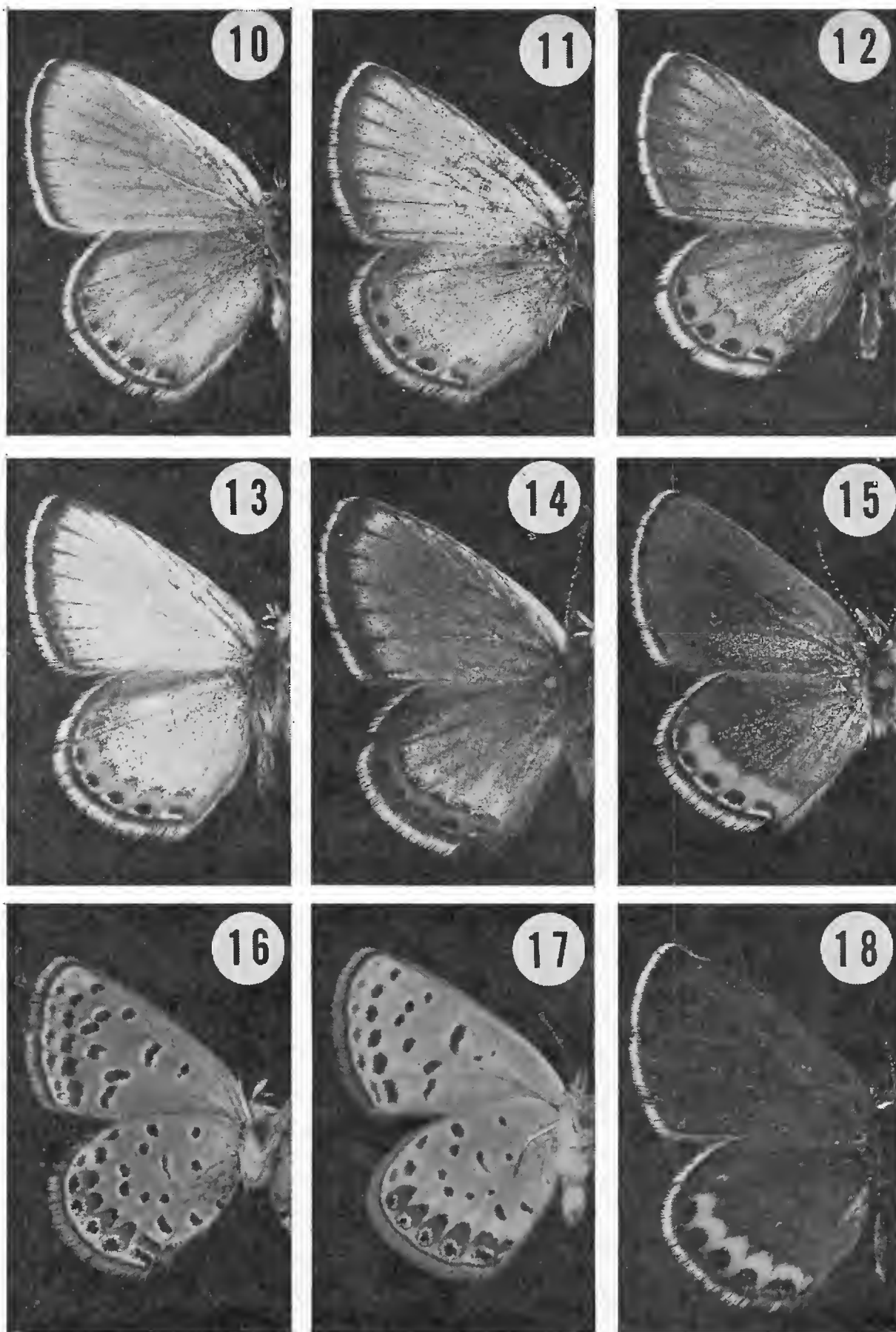
Type 11.7 mm. *Dorsal wing surface*.—Basal one-fifth covered by cyanic overlay. Color and iridescence of overlay as in male. *Ventral wing surface*.—As in male except ground color gray with brownish cast. *Genitalia*.—Sterigma heavily sclerotized, swollen and pointed apically; terminal plate extending basally onto dorsal surface of sterigma as in Fig. 8.

Holotype male and allotype, 1 MI. S. HILLSIDE, YAVAPAI CO., ARIZONA, 30 September 1969, J. A. Scott. Deposited in the Los Angeles County Museum of Natural History, Los Angeles, California. Topoparatypes: 12 ♂, 13 ♀, 30 September 1969; 2 ♀, 21 September 1971, C. E. Goodpasture.

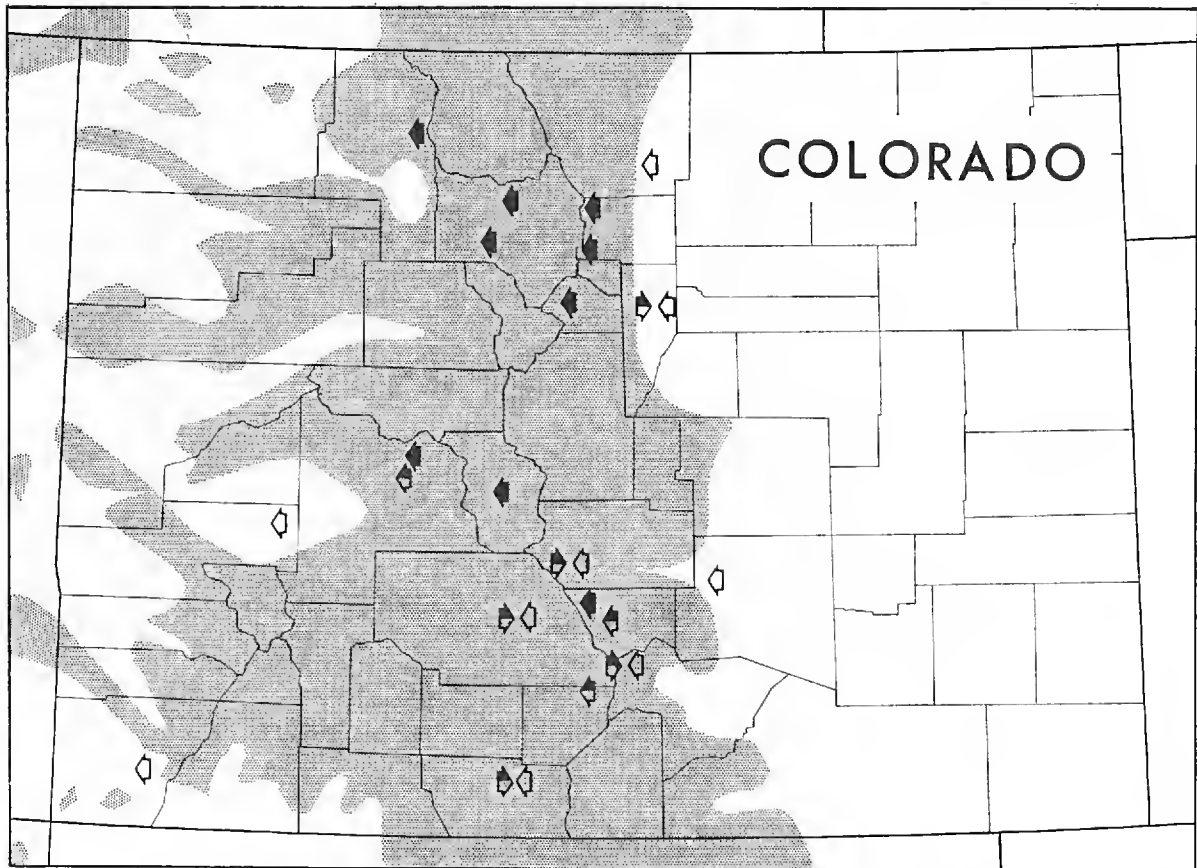
GEOGRAPHICAL DISTRIBUTION (Map 1).—Arizona, New Mexico, western Texas, westcentral Mexico, parts of Colorado, Utah, Nevada, and extreme

←

ventral (lower), and lateral (center) views. FIGS. 1, 4, 7. *Plebejus acmon acmon*. FIGS. 2, 5, 8. *P. acmon texanus*. FIGS. 3, 6, 9. *P. lupini*. ul = uncus lobe, tp = terminal plate.



FIGS. 10-14. Wing upper surface patterns of males of the *Plebejus acmon* complex. FIG. 10. *P. acmon acmon* Briceberg, Mariposa Co., California, 5 May 1969, K. C. Hughes. FIG. 11. *P. acmon lutzi* Pole Mtn., Albany Co., Wyoming, 4 July 1970, C. D. Ferris. FIG. 12. *P. acmon texanus* Holotype. FIG. 13. *P. lupini monticola* Sierra Pelona Road, Mint Canyon, Los Angeles Co., California, emgd. 12 May 1970, C.



Map 2. Distribution of *Plebejus acmon texanus* (open arrows), *P. acmon lutzi* (filled arrows), and *P. acmon texanus*-*P. acmon lutzi* intermediates (divided arrows) in Colorado. Where arrows point to one locality, more than one phenotype occurs. Shading roughly denotes areas above 7,000 feet.

southeastern California. Occurring most commonly in mountains below about 9,000 feet. In southeastern and eastcentral Arizona, Brown (1965) notes Upper Sonoran through Transition zones; elevations 4,000-7,500 feet. In Colorado, *P. acmon texanus* occurs at elevations between about 6,000 and 7,000 feet. At higher elevations, phenotypic blending with *P. acmon lutzi* occurs (Map 2).

←

E. Goodpasture. FIG. 14. *P. lupini lupini* Echo Lake, El Dorado Co., California, 8,000 ft., 10 July 1970, C. E. Goodpasture. Note that darkness of photograph represents darkness of wing color: lightest blue (Fig. 13) = lightest gray; darkest purple (Fig. 14) = darkest gray. FIGS. 15-18. Wing patterns of females: uppersurface Figs. 15 and 18, undersurface Figs. 16 and 17. FIG. 15. *P. acmon texanus* National forest boundary, road to Mt. Lemmon, Pima Co., Arizona, 8 April 1966, J. A. Scott. FIG. 16. *P. acmon texanus* 21 mi. S Alpine, Brewster Co., Texas, 20 September 1970, J. A. Scott. FIG. 17. *P. acmon acmon* Monticello Dam, Yolo Co., California, emgd. 1 May 1970, C. E. Goodpasture. FIG. 18. *P. lupini lupini* 5 mi. N Sun Pass, Klamath Co., Oregon, 18 July 1971, C. E. Goodpasture. All figures $\times 2.2$.

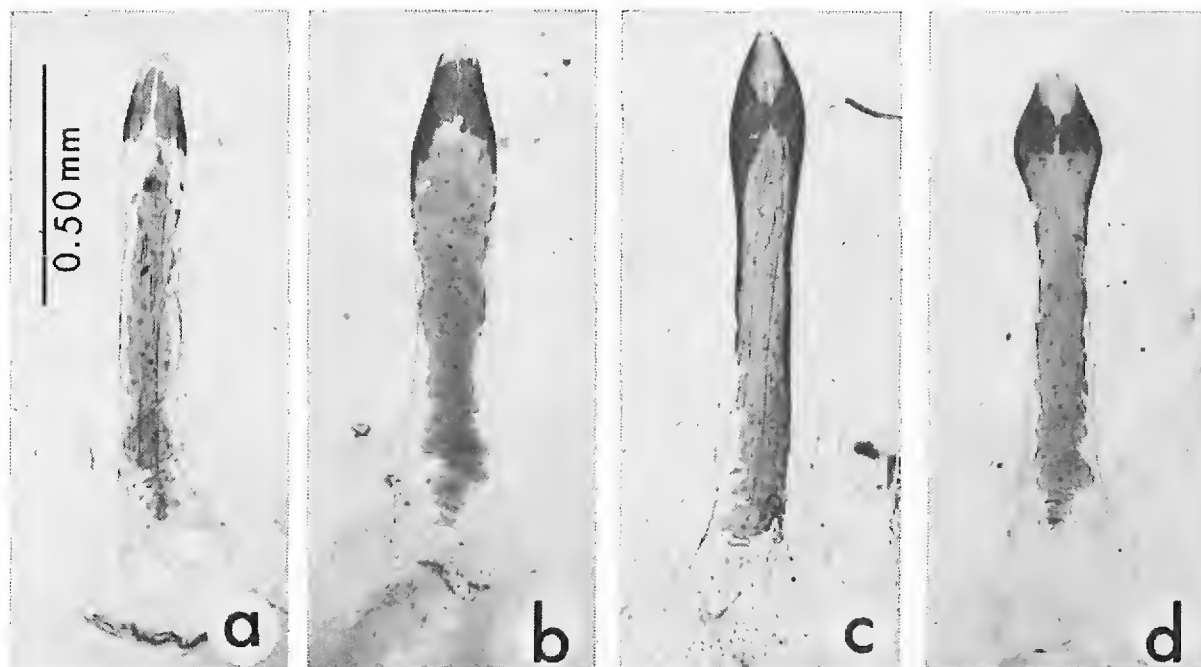


FIG. 19. Variation in sterigma of females of *Plebjus acmon* from Schillings Spring, Conejos Co., Colorado. Morphology as in *P. acmon* (a); *P. a. texanus*-*P. a. lutzi* intermediate (b); *P. a. texanus* (c); similar to *P. lupini* (d).

MATERIAL EXAMINED (600 specimens).—Locality data is given for representative material from throughout the range of *P. acmon texanus*. Genitalia slide mounts were made of all specimens listed. Specimens intermediate in genital morphology between *P. acmon texanus* and *P. acmon lutzi* are indicated.

ARIZONA: *Apache Co.:* Alpine, 7 June 1937, 1 ♂; Turkey Creek Rd., White Mts., 20–21 June 1935, 1 ♀. *Cococino Co.:* 7 mi. SW Williams, 26 July 1970, 1 ♀; Pine Flat Campground, 11 April 1963, 1 ♀. *Greenlee Co.:* Hannagan Meadow, White Mts., 22–27 June 1937, 4 ♂, 3 ♀. *Mojave Co.:* Hualapai Mts., 6 September 1964, 3 ♀. *Pima Co.:* Mt Lemmon, 8 April 1966, 1 ♀; 20 mi. NE Tucson, 4,200 ft., 23 October 1960, 1 ♂. *Yavapai Co.:* 1 mi. S Hillside, 30 September 1969, 2 ♀. **CALIFORNIA:** *San Bernardino Co.:* New York Mts.: 1 June 1968, 4 ♂, 1 ♀; Keystone Canyon, 7 mi. SE Ivanpah, 5,000 ft. and 5,500 ft., 23 September–8 October, 1 ♂, 2 ♀; ¾ mi. SE Horse Thief Springs, Kingston Range, 4,400–4,800 ft., 29 June 1969, 2 ♂; Gilroy Canyon, Providence Mts., 21 April–30 May 1968, 2 ♂. **COLORADO:** *Alamosa Co.:* Great Sand Dunes Nat'l. Monument, 12 June 1945, 2 ♂ (intermediate). *Conejos Co.:* ½ mi. SE Schillings Spring, 9 July 1967, 5 ♀ (2 intermediate); W end of Alamosa Reservoir, 9 July 1967, 2 ♀. *Custer Co.:* Baldy Peak, 12,000 ft., 29 July 1970, 2 ♂; Hermit Pass Rd., 22 July 1968, 1 ♂, 1 ♀; 1.5 mi. NW Westcliffe, 25 July 1965, 3 ♂, 1 ♀. *Fremont Co.:* Bear Creek, 22 June 1970, 1 ♀; Hillside School, 16 August 1968, 2 ♀. *Gunnison Co.:* 9 mi. N Crested Butte, 26–29 July 1966, 1 ♂ (intermediate); Gothic, 31 August 1961, 1 ♂ (intermediate); Taylor River, 10 July 1961, 1 ♂ (intermediate). *Huerfano Co.:* 7 mi. W Malachite, 4 July 1970, 1 ♂. *Jefferson Co.:* 1 mi. W Golden, 10 September 1965, 2 ♂; Phillipsberg, 4 September 1961, 1 ♂ (intermediate). *Larimer Co.:* Round Butte, 29 June 1964, 1 ♂, 1 ♀. *Montezuma Co.:* Mesa Verde Nat'l. Park, 22 July–1 September, 1 ♂, 1 ♀.

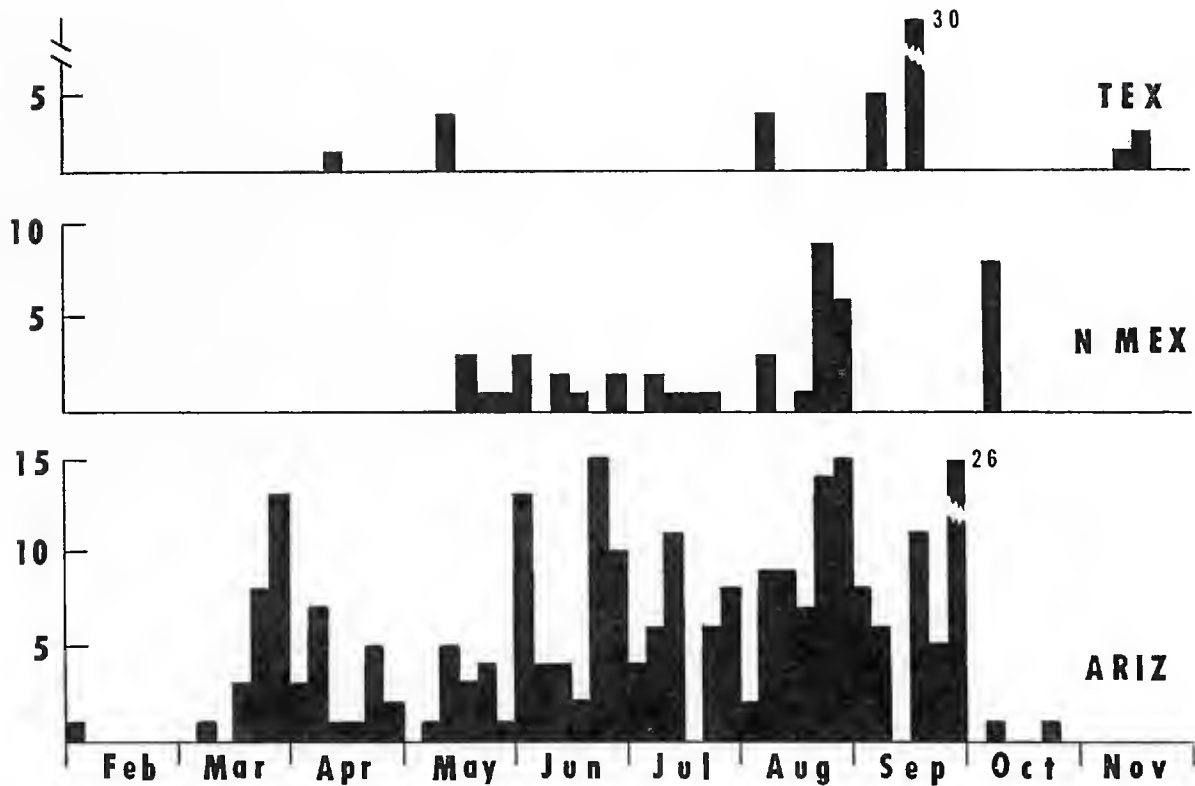


FIG. 20. Seasonal distribution of *Plebejus acmon texanus*.

Pueblo Co.: SW of Pueblo, 31 July 1962, 1 ♂. *Saguache Co.*: Mosca Pass Trail, 8,500 ft., 10 July 1970, 3 ♂; 1 mi. SW Villa Grove, 17 June 1966, 1 ♂. **NEW MEXICO**: *Mora Co.*: 8.5 mi. E Wagon Mound on Hwy 120, 16 August 1970, 1 ♀. *McKinley Co.*: 4 mi. S Fort Wingate, 10 July 1966, 1 ♀. *Sandoval Co.*: Sandia Mts. 8,500 ft., 3 June 1945, 1 ♀. *Sante Fe Co.*: Cerrillos, 17 August 1970, 1 ♀. *Torrance Co.*: Manzanita Mts., 2 June 1945, 1 ♀. **NEBRASKA**: *Phelps Co.*: Atlantic, 23 July 1964, 1 ♂. **NEVADA**: *Douglas Co.*: 1.5 mi. E Glenbrook, 4 June 1970, 1 ♂. *Clark Co.*: Sheep Range, 3-4 mi. NW Mormon Well, 1-2 July 1969, 1 ♂ 1 ♀. *Lincoln Co.*: 10 mi. W Caliente, 6,200 ft., 3 July 1969, 1 ♂. *White Pine Co.*: 1 mi. S Blind Spring, W end Snake Range, 5,800 ft., 29 July 1969, 1 ♂. **TEXAS**: *Brewster Co.*: 21 mi. S Alpine, 8 August-20 September, 3 ♂, 4 ♀. *Jeff Davis Co.*: Fort Davis, 13 May 1962, 1 ♀. **UTAH**: *Washington Co.*: Zion Nat'l. Park, 15 June 1938, 1 ♂, 1 ♀. **MEXICO**: **CHIHUAHUA**: 17 mi. W Chihuahua and 7 mi. E Pedernales, 7,900 ft., 11 July 1964, 2 ♀. **DURANGO**: 22 mi. E El Salto, 8,000 ft., 22 July 1964, 1 ♂. **GUANAJUATO**: 10 mi. N Guanajuato, 4 July 1954, 1 ♂.

SEASONAL DISTRIBUTION (Fig. 20).—Multivoltine; collection records indicate that flight season extends from early spring to late summer. Data from Fig. 20 suggest multimodality of seasonal abundance with one peak in spring and another in late summer. Separate spring and summer flight periods (March-April and mid-August-September) are reported for southeastern Arizona; elevation 4,000-6,000 feet (Brown, 1965).

FOODPLANTS.—Certain perennial, bush-like *Eriogonum* species. Oviposition has been observed on *Eriogonum wrightii* var. *wrightii* Torr. ex Benth. at Hillside, Yavapai Co., Arizona and on *E. racemosum* Nutt.

TABLE I. Major differentiating characters for the *Plebejus acmon-P. lupini* complex. Color terminology follows the Munsell book of color (Anonymous, 1942).

Character	<i>a. acmon</i> and <i>a. lutzi</i>	<i>a. texanus</i>	<i>l. lupini</i> and <i>l. monticola</i>
Male genitalia:			
Shape of lobe of uncus in lateral view.	Small and angulate (Fig. 1).	Small and quadrate (Fig. 2).	Large and strongly quadrate (Fig. 3).
Uncus in dorsal view	Sharply pointed (Fig. 4).	Intermediate (Fig. 5).	Blunt (Fig. 6).
Female genitalia:			
Shape of sterigma.	Tubular (Fig. 7).	Apically bulbous, sharply pointed (Fig. 8).	Apically heart to spade shaped (Fig. 9).
Sclerotization.	Entirely membranous or partly sclerotized. Terminal plate incomplete, confined to ventral apex of sterigma.	Terminal plate complete, extending basad along dorsal surface of sterigma.	As in <i>texanus</i> except basad extension sometimes lacking.
Wing pigmentation (dorsal):			
1. Marginal band on FW of males.	Reduced to a thin terminal line (Fig. 10) in <i>acmon</i> . Broad in <i>lutzi</i> , very broad in melanic <i>lutzi</i> . ¹	Broad (Fig. 11) or broader than as in Fig. 12.	Broad. Very broad in melanic <i>lupini</i> .
2. Basad extension of marginal band along FW veins of males.	Absent or faint. Prominent in melanic <i>lutzi</i> .	Prominent (Fig. 12).	Prominent in <i>lupini</i> . Faint in <i>monticola</i> .
3. Marginal band-overlay transition of males.	Abrupt (Figs. 10, 13). Gradual in melanic <i>lutzi</i> .	Gradual (Fig. 12).	Gradual in <i>lupini</i> . Abrupt in <i>monticola</i> .
4. Approximate hue of iridescence of cyanic overlay.	Purplish Purple-Blue to Purple-Blue Purple. Purple-Blue in some Nevada, Utah and Idaho <i>lutzi</i> .	Purplish Purple-Blue to Purple-Blue Purple.	<i>lupini</i> as in <i>texanus</i> : tending toward Blue Purple-Blue E. of the Sierra Nevada. <i>monticola</i> : Blue Purple-Blue to Purple-Blue in S. Calif. (= type <i>monticola</i>), Greenish Blue-Green to Blue-Green in some Kern & L. A. Co. specimens (= type <i>chlorina</i>); usually as in <i>texanus</i> and <i>lupini</i> in San Diego Co. south.

TABLE I. (Cont.)

Character	<i>a. acmon</i> and <i>a. lutzi</i>	<i>a. texanus</i>	<i>l. lupini</i> and <i>l. monticola</i>
5. Distal insulae of HW of males.	Separate from terminal line. Fused with terminal line in melanic <i>lutzi</i> .	Separate from terminal line.	Usually fused with terminal line in <i>lupini</i> . Usually separate in <i>monticola</i> .
6. Color of submarginal band on HW of males.	Pink in <i>acmon</i> . Orange in <i>lutzi</i> .	Orange.	Orange.
7. Border proximal to submarginal band.	Absent in <i>acmon</i> . Usually present in <i>lutzi</i> .	Present	Present in <i>lupini</i> except at low elevations E. of the Sierra Nevada. Usually present in <i>monticola</i> .
8. Dark scales at apex of FW discal cell in males.	Absent in <i>acmon</i> . A few scales in <i>lutzi</i> .	Distinct scale patch.	Absent in <i>monticola</i> . <i>lupini</i> as in <i>lutzi</i> .
9. Dark scales scattered over wing surface.	Absent or few. Many in melanic in <i>lutzi</i> .	Many.	Absent or few. Many in melanic <i>lupini</i> .
10. Color of forewing in males.	Purple of high saturation and brilliance in <i>acmon</i> . Purple to Blue, usually of high saturation and brilliance in <i>lutzi</i> .	Purple of low saturation and brilliance.	<i>lupini</i> as in <i>texanus</i> . <i>monticola</i> : as in <i>lupini</i> to Blue (type <i>monticola</i>) or Blue Green (type <i>chlorina</i>) of high saturation and brilliance, sometimes largely brown in Tehachapi Mts., S. Calif.
11. Range in percent of wing surface covered by overlay in females.	90 to 0 in <i>acmon</i> , highest in overwintering and spring generations (= type <i>cottlei</i>) 25 (Fig. 15) to 0 (Fig. 18) in <i>lutzi</i> .	As in <i>lutzi</i> .	25 to 0 in <i>lupini</i> . 90 to 0 in <i>monticola</i> , highest in L. A. Co., Calif. (= type <i>monticola</i>).

¹ Melanic specimens of *P. acmon lutzi* and *P. lupini lupini* are extensively dark scaled and are similar or identical in wing characters. Known from higher elevations and more northern latitudes.

at Mesa Verde National Park, Montezuma Co., Colorado. Associations of adults with *E. effusum* Nutt. in Colorado and *E. corymbosum* var. *velutinum* Reveal & Brotherson in New Mexico suggests that these plants are also utilized. More complete data on foodplant use are given elsewhere (Goodpasture, 1973b). The type series was collected in association with *E. wrightii* var. *wrightii*.

DISCUSSION

Morphological character combinations that differentiate *P. acmon texanus* from other members of the *P. acmon*-*P. lupini* complex are summarized in Table I. Variability of the diagnostic characters listed is least in morphology of female genitalia and greatest in uppersurface wing patterns of males. It should be noted that females lack diagnostic external characters. Species designations of *P. acmon* group females can not be made without examination of the genitalia. Subspecies assignments within *P. acmon* and *P. lupini* usually require series of both sexes.

In external phenotype *P. acmon texanus* closely resembles *P. lupini lupini* in uppersurface wing color (characters 6 and 10 of Table I), forewing marginal band (3, 4 and 5), color of hindwing submarginal band (8) and presence of a dark border proximal to hindwing submarginal band (9). These two subspecies differ primarily in intensity of expression of characters. For example, on the uppersurface of the primaries, discal scale spot and basad extension of marginal band scales along veins are strongly expressed in *P. acmon texanus* and weak or absent in all but strongly melanic *P. lupini lupini*. It is of interest that at least one high elevation population (Mono Pass, California) of *P. lupini lupini* is composed largely of individuals pigmentationally indistinguishable from *P. acmon texanus*. Of ten male wing pigmentation characters listed in Table I, at least nine are shared by some specimens of both *P. acmon texanus* and *P. lupini lupini*, whereas approximately six characters are shared with *P. lupini monticola*, and *P. acmon lutzi* and only one or two with *P. acmon acmon*.

Genital morphology in *P. acmon texanus* appears intermediate between that of *P. acmon* and *P. lupini*. Genital characters most consistently differentiating these two species are in males, the uncus, and in females, the extensible ostium bursa (sterigma). The sharply pointed terminal plate of *P. acmon texanus* is unique among *P. acmon* group members.

Plebejus acmon texanus is treated as a subspecies of *P. acmon* rather than of *P. lupini* which it most closely resembles because of the occurrence of intergradation with *P. acmon* in at least some areas between

the ranges of the two entities. In Colorado, several populations include individuals that are morphologically intermediate between *P. acmon texanus* and *P. acmon lutzi*. At these localities variation in genital morphology is unusually great. For example, at Schillings Spring, sclerotization of the extensible organ in females ranges from complete as in *P. acmon texanus* to incomplete as in *P. acmon acmon* and *P. acmon lutzi* (Fig. 13). Localities in Colorado where pigmentational and/or genitalic intermediates have been collected are shown in Map 2. A "blend zone" following an altitudinal as well as a geographic gradient is indicated by the data plotted. Whether or not this apparent zone of intergradation and marked variation occurs in other areas between the ranges of *P. acmon texanus* and *P. acmon lutzi* is unknown.

At the extreme western edge of the distribution of *P. acmon texanus*, a different situation may exist. Small series of *P. acmon* examined from desert mountains of southeastern California include both *P. acmon texanus* and *P. acmon acmon* but not intermediate phenotypes. Further collecting at these and other localities at the margins of the distribution of *P. acmon texanus* is needed to help clarify these situations.

ACKNOWLEDGMENTS

Appreciation is expressed to the following persons and institutions for the loan of specimens without which this study could not have been undertaken: J. P. Donahue (Los Angeles County Museum of Natural History), C. D. Ferris (Laramie, Wyoming), G. A. Gorelick (Azusa, California), Chris Henne (Pearblossom, California), K. C. Hughes and R. E. Stanford (Los Angeles, California), J. A. Powell (University of California at Berkeley), C. A. Sekerman (Los Angeles, California), J. A. Scott (formerly University of California at Berkeley), Oakley Shields (University of California at Davis).

LITERATURE CITED

- BROWN, K. S. 1965. Some comments on Arizona butterflies. *J. Lepidopt. Soc.*, 19: 107-115.
- GOODPASTURE, C. E. 1973a. Biology and systematics of the *Plebejus* (*Icaricia*) *acmon* group. *J. Kansas Entomol. Soc.* (In press).
- 1973b. Foodplant specificity in the *Plebejus* (*Icaricia*) *acmon* group. *J. Lepidopt. Soc.* (In press).

New Ephemerellidae from Madagascar and Afghanistan¹
(Ephemeroptera)

RICHARD K. ALLEN

California State University, Los Angeles, 90032

A collection of Ephemerellidae from W. Wittmer of the Naturhistorisches Museum, Basel, Switzerland, included an undescribed genus and species represented by two female imagoes. A third female imago was examined at the University of Utah, Salt Lake City, with the permission of G. F. Edmunds, Jr. The forewing characters of *Manohyphella* n. gen. are similar to *Teloganella* Ulmer, *Teloganodes* Ulmer, and *Ephemerellina* Lestage, and it is herein included, with the above genera, in the subfamily Teloganodinae. Two undescribed species of *Ephemerella* Walsh were also included in a collection of nymphs from Afghanistan which were loaned to the author by G. F. Edmunds, Jr. One belongs in *Drunella* Needham and is the eighteenth species in the subgenus known to occur in Asia. The other is a representative of *Serratella* Edmunds and constitutes a new Asian record for the subgenus as the taxon was previously reported from only North America.

***Manohyphella* Allen, new genus**

Small mayflies with robust body and proportionately narrow wings. Forewings with long connected or unconnected intercalaries. Intercalaries of forewing reduced in number with only one between IMP and MP₂, only one between MP₂ and CuA, and only three between CuA and CuP (Fig. 2). Hindwings proportionately small and costal projection sharp and at apex of wing (Fig. 3).

TYPE SPECIES.—*Manohyphella keiseri* Allen, new species

This is the third genus of Ephemerellidae to be reported from the Ethiopian Region. *Ephemerellina* was described from South Africa, and is now known from Australia and eastern China. Allen and Edmunds (1963) reported a record of *Ephemerella* (*Eurylophella*) Tiensuu from Madagascar, but they considered it questionable and possibly due to a labeling error. *Manohyphella* is distinguished from the other described Teloganodinae by the character of the hindwing. The costal projection of *Ephemerellina* is in the anterior half of the wing, the projection is blunt and symmetrical, and there are usually between fifteen and twenty crossveins in the wing (Fig. 5). In *Teloganella* and

¹ The research on which this paper is based was supported by National Science Foundation Grant GB-35591, and the University of Utah collections on which parts of this paper are based were obtained with National Science Foundation grant support to G. F. Edmunds, Jr.

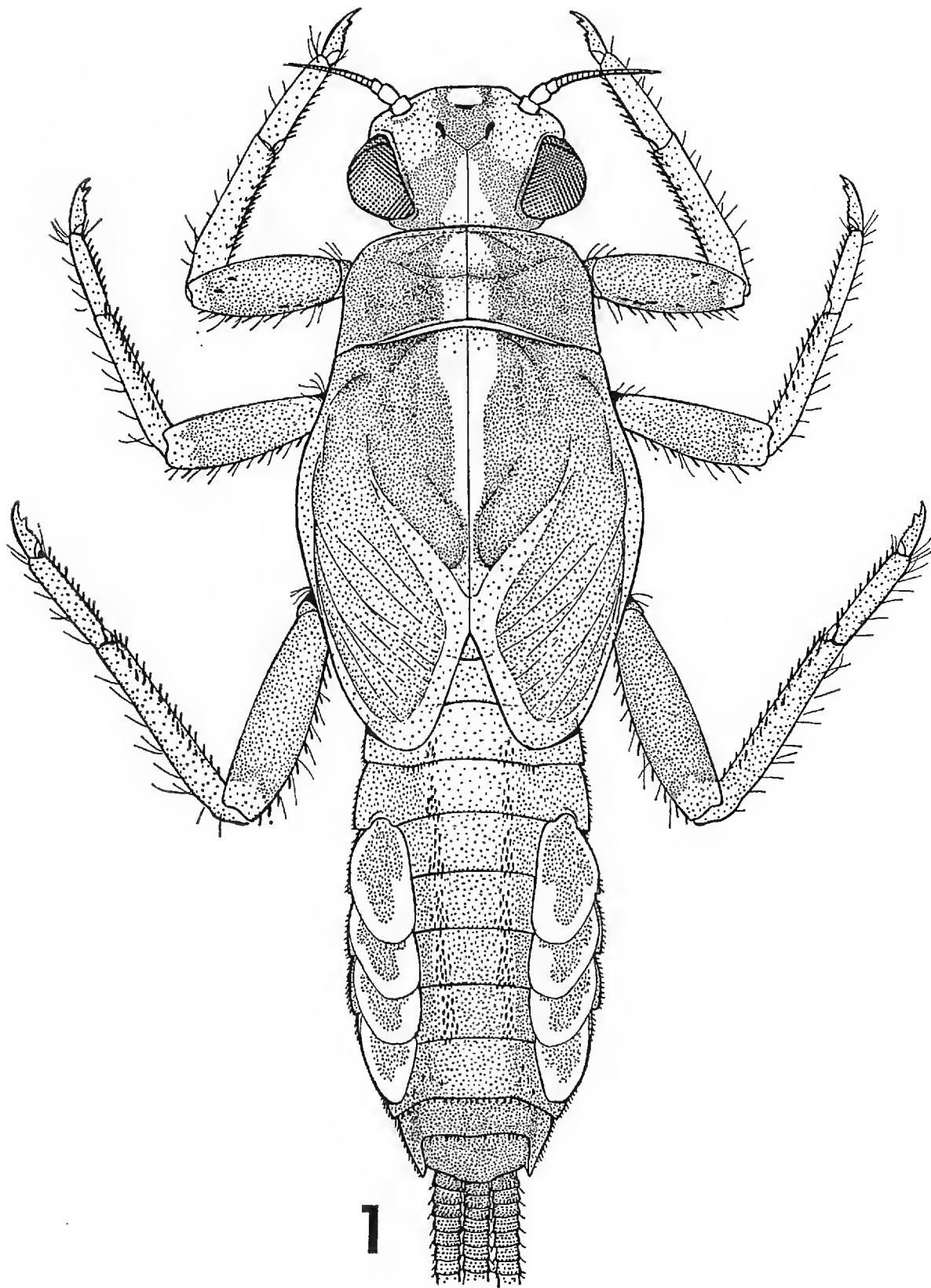
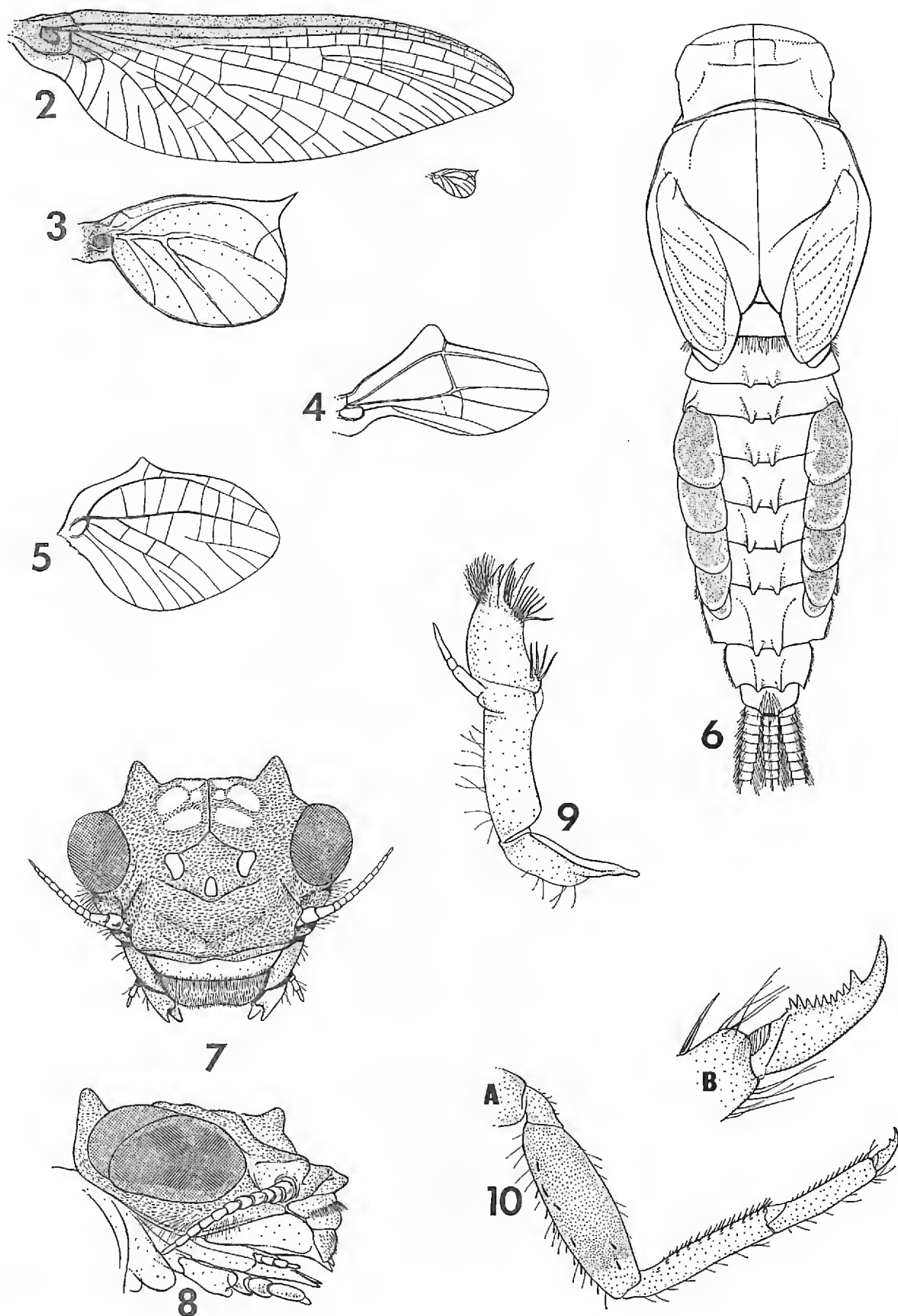


FIG. 1. *Ephemerella* (*Serratella*) *subsolana* Allen, n. sp., mature nymph, dorsal view.

Teloganodes, the costal projection is blunt and asymmetrical, and there are usually less than five crossveins in the wing (Fig. 4). The above two genera are further characterized by well-developed prominent crossveins arising from the posterior margin of the costal projection and



FIGS. 2-3. *Manohyphella keiseri*, wings. FIG. 2, forewing. FIG. 3, hindwing. FIG. 4. *Teloganella*, hindwing. FIG. 5. *Ephemerellina*, hindwing. FIGS. 6-8. *Ephemerella (Drunella) kabulensis*, nymphal structures. FIG. 6, thorax and abdomen, dorsal view. FIG. 7, head, front view. FIG. 8, head, side view. FIGS. 9-10. *Ephemerella (Serratella) subsolana*, nymphal structures. FIG. 9, maxilla. FIG. 10a, right fore leg. FIG. 10b, tarsal claw.

extending to the subcosta and the radius (Fig. 4). The costal projection of the hindwing of *ManohypHELLA* is in the posterior half of the wing, the projection is sharp and symmetrical, and there are only two crossveins in the wing. The crossveins originate near the posterior margin of the costal projection, as in *Teloganella* and *Teloganodes*, but they are poorly developed and barely discernible (Fig. 3).

ETYMOLOGY.—*ManohypHELLA* is from the Greek words *manos* meaning rare and *hyphe* meaning web, and from the Latin diminutive *ella*.

ManohypHELLA keiseri Allen, new species

FEMALE IMAGO.—Length: body 5.0–6.0 mm; forewing 10.0 mm. General color reddish brown to black. Head dark brown. Pronotum reddish brown; pronotum with median elevated longitudinal ridge; mesonotum reddish brown with dark markings along sutures; metonotum with prominent posterior submedian flap-like structures; forewings hyaline, stigmatic area and base of wings brown (Fig. 2); longitudinal veins black, hindwings hyaline, base of wings marked with brown; longitudinal vein brown (Fig. 3); legs light brown. Abdomen reddish brown without distinctive markings. Caudal filaments yellowish brown.

Holotype female imago, RANOMAFANA, MADAGASCAR, 12 September 1958, F. Keiser, in collection Naturhistorisches Museum, Basel, Switzerland. Paratopotype, female imago, same data and deposition as holotype. Paratype, female imago, Farimbony Riv., at R. N. 2, Prov. Tamatave, Madagascar, 15 October 1971, G. F. and C. A. Edmunds, F. Emmanuel, in collection University of Utah, Salt Lake City.

ETYMOLOGY.—Named in honor of F. Keiser, the collector of the holotype.

Ephemerella (Drunella) kabulensis Allen, new species

MATURE NYMPH.—Length: body 9.5–10.5 mm; caudal filaments 6.0–7.0 mm. General color light brown. Head brown with dark transverse band across anterior margin of compound eyes; head with moderately developed paired occipital tubercles (Fig. 7), with moderately developed median tubercle on frons between compound eyes (Fig. 8), and with short lateral genal projections. Thorax light brown; thoracic nota without tubercles, but often with scattered long setae; legs brown; ventral (leading) edge of fore femora with tubercles; anterior margin of fore femora with longitudinal ridge near middle of segment and median transverse ridge extending from longitudinal ridge to anterior margin of segment; apical tibial projection straight and moderately developed; tarsal claws with 1 or 2 subbasal denticles. Abdominal trega brown; terga 2–10 with paired submedian tubercles; tubercles moderately developed on terga 2–9, small on tergum 10; terga 2–9 often with scattered long setae; tergum 1 with row of setae along posterior margin and tergum 10 with median tuft of setae (Fig. 6); abdominal sterna light brown. Caudal filaments light brown.

Holotype mature nymph, KABUL RIVER NEAR PAGHAM, KABUL PROVINCE, AFGHANISTAN, 26 August 1967, M. Nazim, in collection University of Utah, Salt Lake City. Paratopotypes, 68 nymphs, same data as holotype, 10 nymphs in collection California State University, Los Angeles, and 5 each in collections of California Academy of Sciences, San Francisco, and the Canadian National Collection, Ottawa; 13 nymphs, 25 May 1967, M. Nazim; 5 nymphs, 9 August 1967, G. Sharafi *et al.*; 2 nymphs, 8 April 1967, M. Nazim; 7 nymphs, 29 June 1967, M. Nazim. Paratypes, 14 nymphs, Kabul River nr. Dara Pagnan, Kabul Prov., Afghanistan, 8 April to 26 July 1967, M. Nazim; 28 nymphs, Kabul River nr. Dara Pagnan, Kabul Prov., 7 July to 1 August 1967, G. Sharifi *et al.*; 7 nymphs, Pang Shir River, 5 km. N. Charikar, Parwan Prov., Afghanistan, 9 July 1967; 5 nymphs, Ciakhak Maidan, Wardek Prov., Afghanistan, 15 July 1967, G. Sharifi *et al.*; 5 nymphs, Ghalkaii, Gardez, Paktia Prov., Afghanistan, 28 July 1967, G. Sharifi *et al.*, all paratypes except as noted in collection University of Utah.

ETYMOLOGY.—The name is based upon the type locality, the Kabul River.

***Ephemerella (Serratella) subsolana* Allen, new species**

MATURE NYMPH.—Length: body 6.0–7.0 mm; caudal filaments 4.5–5.5 mm. General color light brown. Head light brown with Y-shaped brown marking (Fig. 1); head without tubercles or projections; maxillary palpi moderately well-developed and three-segmented (Fig. 9). Thoracic nota light brown with pale median longitudinal stripe (Fig. 1); femora light brown, pale at apices; anterior surface of fore legs with spines (Fig. 10a); tibiae and tarsi pale; tarsal claws with 8–10 denticles (Fig. 10b). Abdomen brown; abdominal terga without tubercles, but with paired submedian elevated ridges on terga 2–7; ridges covered with heavy short spicules (Fig. 1); tergum 8 with scattered spicules, and terga 8–9 with marginal spicules; abdominal sterna brown, darker posteriorly. Caudal filaments brown basally, light apically.

Holotype mature nymph, KABUL RIVER, KOTASUNGI, KABUL PROVINCE, AFGHANISTAN, 13 May 1967, M. Nazim, in collection University of Utah, Salt Lake City.

ETYMOLOGY.—The name is from the Latin word *subsolanus* meaning eastern.

LITERATURE CITED

- ALLEN, R. K. AND G. F. EDMUNDS, JR. 1963. New and little known Ephemerellidae from southern Asia, Africa, and Madagascar (Ephemeroptera). *Pac. Insects*, 5: 11–22.

A Redescription of the Scorpion *Vejovis flavus*

(Scorpionida: Vejovidae)

MICHAEL E. SOLEGLAD

3927 Polack Street, San Diego, California 92110

In 1900, Nathan Banks listed the new scorpion *Vejovis flavus* Banks. Unfortunately, Banks' description was comprised of only a few statements embedded in a key. To the best of my knowledge these statements are the only descriptive information on *V. flavus*. Evidently, Banks' knowledge of *V. flavus* was based on a single female specimen from Albuquerque, New Mexico.

In recent years *Vejovis confusus* Stahnke of Arizona and southern Nevada has been confused with *V. flavus*. Due to this association with *V. confusus*, *V. flavus* has been considered a member of the eusthenura group of *Vejovis*. The findings of this study verify that *V. flavus* is a member of the eusthenura group although displaying some interesting deviations from the group.

I am grateful to Dr. Herbert W. Levi of the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, for the loan of the type specimen.

VEJOVIS FLAVUS Banks

(Figs. 1-6; Table 1)

DIAGNOSIS.—A unique member of the eusthenura group, somewhat related to *Vejovis confusus* of Arizona and southern Nevada from which it can be separated by the following characters: Inferior median keels delicately crenulate on all caudal segments instead of smooth on segments I-II; chelal carinae distinct, superior, inner accessory, and inner carinae mildly crenulate as opposed to smooth; pectinal tooth count greater, 21-22 for female, in contrast to 13-17.

HOLOTYPE FEMALE.—Entire specimen dark orange, undoubtedly caused by prolonged preservation. Eyes and aculeus dark brown to black. No other detectable markings. *Structure*: Measurements as given in table 1. *Carapace*: Posterior surface covered with coarse granules, ocular triangle smooth; longer than wide, anterior region noticeably narrowed (Fig. 2); shorter than fifth caudal segment. Anterior edge essentially straight; median tubercle situated somewhat anterior, in ratio 3.1/8.6; median eyes and tubercle small, one-fifth width of carapace at that point. Posterior lateral eye reduced considerably, anterior two approximately same size. *Preabdomen*: All tergites granulated on extreme posterior edges; seventh tergite with two pairs of serrate keels. Sternites smooth with slit-like stigmata; sternite V lacking keels. *Cauda*: Basal segment wider than long. Seg-



FIG. 1. *Vejovis flavus* Banks, holotype female, dorsal view.

ments I–IV: Dorsal and dorsal lateral keels serrate, ending in elongate posterior spine. Lateral keels crenulate on segment I, crenulate on posterior third of II, posterior quarter of III, and absent on IV. Inferior lateral keels crenulate; inferior median keels delicately crenulate on posterior two-thirds of segment I and on entirety of II–IV. Segment V: Dorsal keels granulate; lateral keels granulate on anterior half; inferior lateral keels serrate; inferior median keel crenulate to serrate. Intercarinal spaces essentially agranular. *Telson*: Vesicle not as wide or deep as fifth caudal segment width; ventral surface with mild granulation. Very weak subaculear nodule at base of aculeus; aculeus short with average curve (Fig. 3). *Pectines*: Well developed (Fig. 4); three times as long as widest point. Pectinal tooth count 22/21 for female; middle lamellae 13. Basal piece separated on anterior half, length/width ratio 1.8/2.6. Genital operculum completely fused. *Chelicerae*: Lower edge of movable finger smooth with weak serrulae on distal portion; lower distal tooth of movable finger noticeably longer than upper counterpart. Other dentition standard for Vejovinae. *Pedipalps*: Femoral carinae serrate; inner face with 7–9 serrate granules. Dorsal carinae of tibia crenulate; inner ventral carina crenulate to serrate, exterior ventral carina smooth; inner proximal projection reduced, armed with 7–9 crenulate granules. All eight carinae of chela developed; inner, inner accessory, and superior carinae subtly crenulate, other carinae smooth. Movable finger shorter than either carapace or fifth caudal segment. Teeth in single straight row, little to no scalloping (Fig. 5). Supernumerary teeth number six on fixed finger and seven on movable finger. Trichobothrial pattern (Fig. 6) with counts standard for genus: 26 chela, 19 tibia, and 3 femur. *Walking legs*: Single file of delicate spines flanked by longer setae on tarsus venter. Carinae of patellae delicately crenulate.

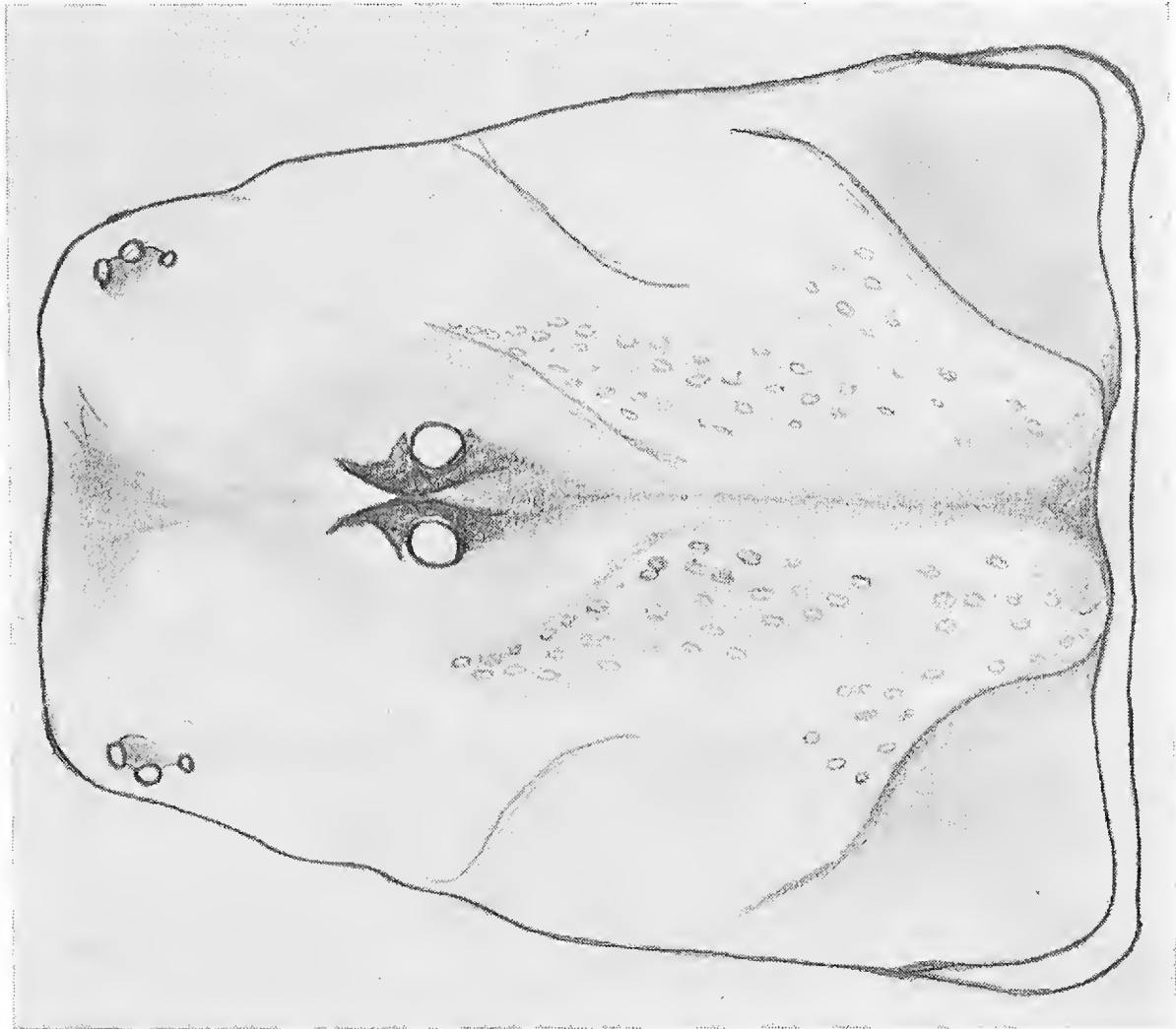


FIG. 2. *Vejovis flavus* Banks, holotype female, carapace.

MALE.—Unknown.

TYPE DATA.—Holotype female from Albuquerque, New Mexico. Date and collector information are missing from the original specimen label. Specimen is in remarkably good condition. Base color is dark, un-



FIG. 3. *Vejovis flavus* Banks, holotype female, telson, lateral view.

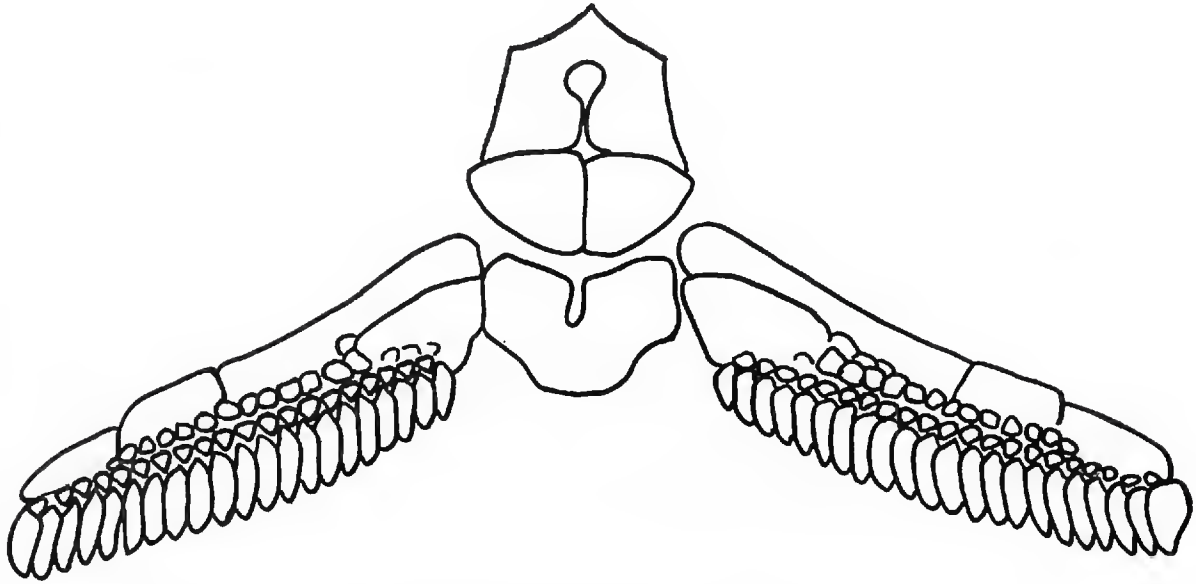


FIG. 4. *Vejovis flavus* Banks, holotype female, pectines.

doubtedly caused by prolonged preservation. Subtle setation has been essentially obliterated throughout the years.

DISTRIBUTION.—Known from type locality only.

COMMENTS.—Brief as Banks' description was, I found a couple of discrepancies in comparing it with the holotype female. In the key, Banks states that *V. flavus* has smooth chelal palms. However, the holotype is equipped with carinae on its chelae, some even crenulate. At this point in the key Banks is contrasting *V. flavus* with *Vejovis punctipalpi* (Wood) a species whose chelae are heavily crested, much more so than *V. flavus*. Also, Banks' states that the inferior median keels of the first caudal segment are plain whereas on the holotype they are weakly crenulate on the posterior two-thirds.

Although a member of the eusthenura group, *V. flavus* presents two

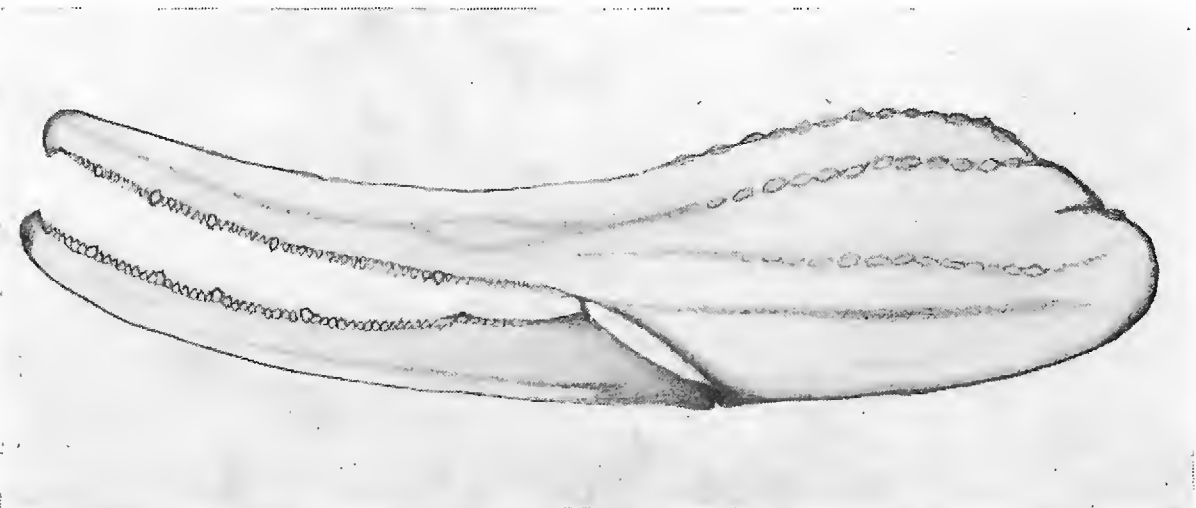


FIG. 5. *Vejovis flavus* Banks, holotype female, chela, lateral view.

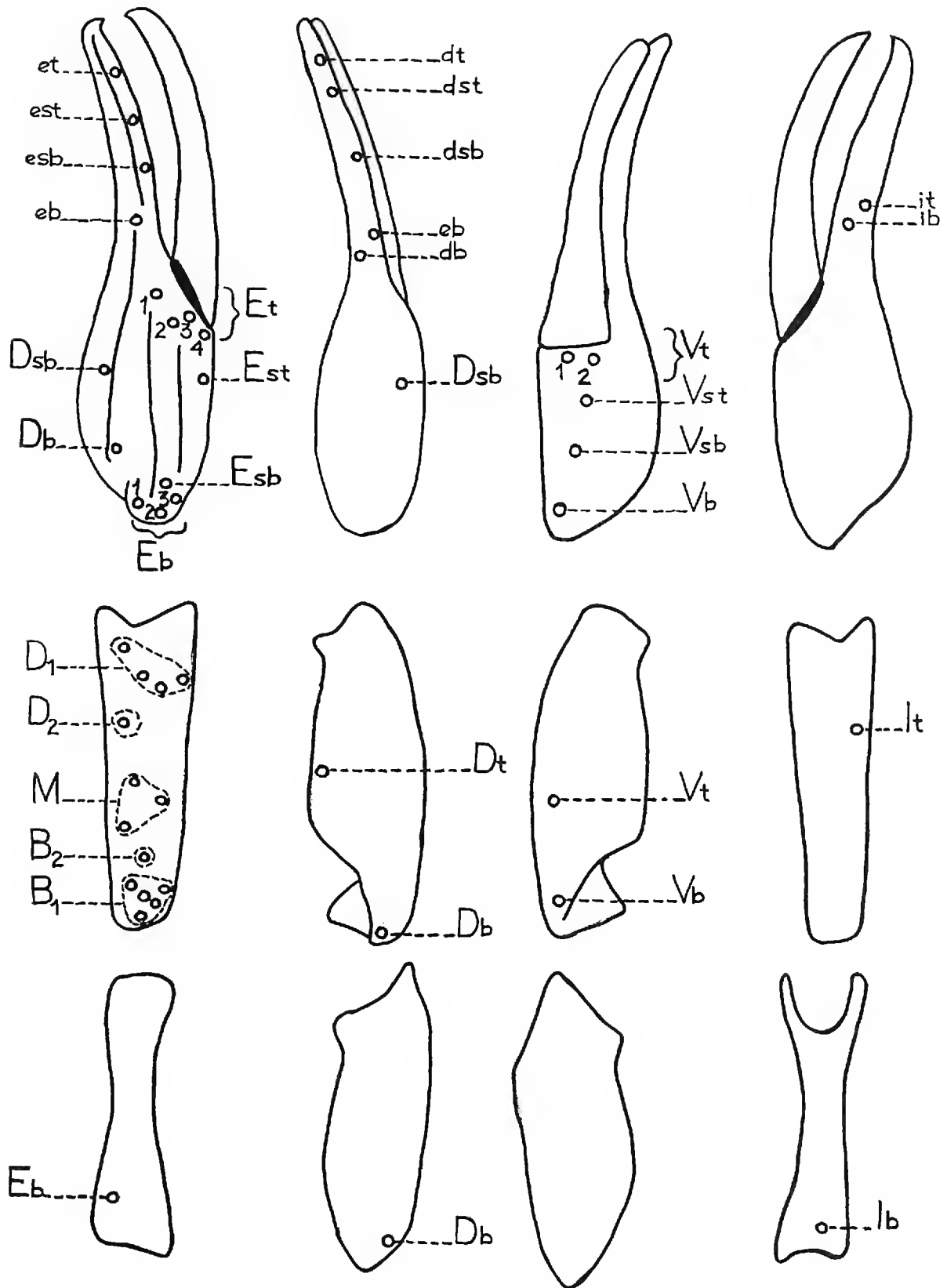


FIG. 6. *Vejovis flavus* Banks, holotype female, trichobothrial pattern of chela (top row), tibia (middle row), and femur (bottom row). Exterior (left column), dorsal (left middle column), ventral (right middle column), and interior (right column) views. Letter abbreviations: E and e, exterior; D and d, dorsal; I and i, interior; V, ventral; M, median; B and b, basal; t, terminal; st, subterminal; sb, subbasal.

TABLE 1. Measurements (in millimeters) of *Vejovis flavus* Banks.

	Holotype (female)
Total length	33.9
Carapace, length	5.0
Width at lateral eyes	2.7
Width at caudal edge	4.4
Preabdomen, length	12.1
Postabdomen, length	16.8
Caudal segment I (length/width/depth)	2.3/2.6/2.0
Caudal segment II (length/width/depth)	2.7/2.5/2.0
Caudal segment III (length/width/depth)	3.0/2.5/2.0
Caudal segment IV (length/width/depth)	3.5/2.4/2.0
Caudal segment V (length/width/depth)	5.3/2.2/1.9
Telson, length	4.7
Vesicle (length/width/depth)	2.7/1.6/1.3
Aculeus, length	2.0
Pedipalp, length	15.2
Femur (length/depth)	4.0/1.2
Tibia (length/depth)	4.1/1.6
Chela, length	7.1
Palm (length/width/depth)	2.9/1.9/1.6
Fixed finger, length	3.4
Movable finger, length	4.4
Pectines	
Teeth	22/21
Middle lamellae	13

interesting deviations from the definition given by Williams (1970). The carinal structure of the chelae is not characteristic of the eusthenura group which normally has reduced chelal palms, and the carinae, if present, are usually underdeveloped and smooth. The pectinal tooth count of the female is somewhat large for this group, exceeding all the other known species, male as well as female. By projecting from a maximum total length/pectinal tooth count ratio for the eusthenura group, one may suspect that the female holotype is not fully matured.

LITERATURE CITED

- BANKS, N. 1900. Synopses of North-American Invertebrates. Amer. Natur., 34(401): 421-427.
- WILLIAMS, S. C. 1970. New Scorpions Belonging to the Eusthenura Group of *Vejovis* from Baja California, Mexico (Scorpionida: Vejovidae). Proc. Calif. Acad. Sci., 4th ser., 37(12): 395-417.

Unisexual Generation of *Andricus atrimentus*

(Hymenoptera: Cynipidae)

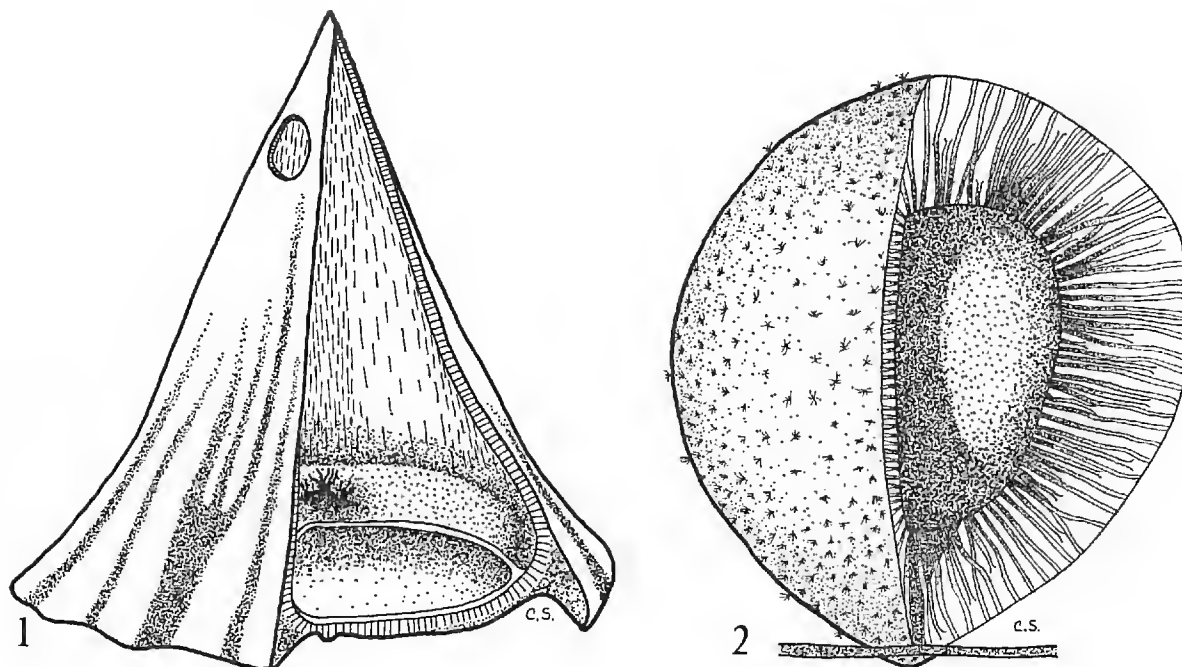
D. CHARLES DAILEY AND CHRISTINE M. SPRENGER

Sierra College, Rocklin, California 95677

The previously undescribed unisexual generation of *Andricus atrimentus* Kinsey (1922), a cynipid gallmaker occurring on *Quercus douglasii* Hooker & Arnott has formerly been considered identical to *Andricus kingi* Bassett from *Quercus lobata* Nee, both *Lepidobalanus* or white oaks. This was probably due to the similarity of their unisexual generation galls (Weld, 1957). Both are red, conical, detachable leaf galls. Weld reared insects and supplied unisexual generation galls of *Andricus atrimentus* to Houard (1946). Due to the coriaceous mesoscutum of the unisexual generation, the species is hereby removed from its present assignment in *Dros* Kinsey and returned to its original placement in *Andricus* Hartig. Kinsey's description of the tarsal claws being simple in the bisexual generation insects is erroneous. Toothed condition of the claws is consistent with the unisexual generation, its occurrence on white oaks, and its placement in *Andricus*.

FEMALE WASP.—*Head*: coriaceous; cheeks not widened behind eyes, slightly narrower than thorax, occiput not concave; malar space 0.4 eye height, not grooved; antennae filiform, segment one longer than two, segment three longer than four, 14 segmented with 13 = 14 or 13 with 13 twice as long as 12. *Thorax*: mesoscutum polished coriaceous, smoother posteriorly, longer than broad, sparsely pubescent; anterior parallel lines indistinct, less than one-half length of mesoscutum; notaulices complete, polished, wider posteriorly; median groove distinct, only slightly longer than width of notaulix at the scutellar suture; parapsidal lines indistinct. Scutellum reticulate posteriorly, sparsely pubescent with smooth area behind foveae; foveae smooth, polished, bare. Propodeum rugose. Wing surface and hind margin pubescent, aerolet $\frac{1}{10}$ to $\frac{1}{12}$ length of first cubital cell, occasionally obsolete in plesiotypes; cubital and radial cells open, radial cell 3.5 times as long as high; R_1 vein arcuate. Tarsal claws toothed. *Abdomen*: slightly longer than head plus thorax, slightly longer than high. Tergite II pubescent at base, II–VII micropunctate, more than two tergites visible in dorsal view. Ventral spine nine times as long as wide, six times as long as high, sparsely pubescent. Color; body uniform dark amber to brown; wing veins yellow to yellow-brown; legs and antennae yellow-brown, latter darker distally. Size: 2.0 mm. Range of 10 specimens 1.7 to 2.2 mm body length (average of 10 specimens 2.0 mm). Total number of specimens 40.

GALL.—Monothalamous, conical, flat-based, detachable, on lower leaf margin. Sides nearly straight, flaring slightly at base. Basal larval cell oval in side view, 1.6 mm in diameter, 0.8 mm high, pubescent. Upper surface of larval cell coriaceous with sparse pubescence; brown, darker towards center. Red and yellow striped



FIGS. 1, 2. *Andricus atrimentus*. 15 × Life Size. FIG. 1. Unisexual generation gall. FIG. 2. Bisexual generation gall.

when fresh, turning to brown and yellow with age (Fig. 1). Size: Height 3.6 to 4.6 mm (average of 10 galls 3.9 mm); width 3.0 to 4.6 mm (average of 10 galls 3.3 mm). Total number of specimens 20.

SYSTEMATICS.—The unisexual generation of *Andricus atrimentus* can be distinguished from *Andricus kingi* by the following characteristics. *Andricus atrimentus* has the head not broadened behind the eyes and slightly narrower than thorax, mesoscutum and scutellum sparsely pubescent, galls red and yellow striped with lateral edges flat or down curved. *Andricus kingi* has the head distinctly narrower than thorax and head broadened behind eyes, mesoscutum and scutellum pubescent, galls red with lateral edges recurved. Rearings of *A. kingi* by Rosenthal and Koehler (1971) and the senior author (unpublished) also confirm separate identity of the bisexual generations of these two species.

LIFE HISTORY.—Five years of field observations by the senior author on an isolated *Quercus douglasii* at Davis, Yolo County, California have shown that the *A. atrimentus* bisexual generation females emerge between 1 and 30 April over a two week period and usually oviposit in the lower leaf surface near the margin. Within 60 days small tan to pink blisters appear at oviposition sites. During the next 30 days galls develop the final conical shape (Fig. 1). Pupation occurs during late October to November and emergence of the unisexual generation females occurs on warm days in late winter. They then oviposit in leaf

buds and when the buds open the leaves already contain small blisters. By mid March the integral leaf galls of the bisexual generation usually reach full size and the outer white layer develops its pink tinted tissue paper texture. The blue-black larval cell is connected to the outer layer by numerous blue-black filaments which become white distally (Fig. 2).

HOST.—*Quercus douglasii*; similar galls noted on *Quercus dumosa* Nuttall and *Quercus turbinella californica* Tucker but not confirmed by reared insects. Numerous attempts to rear the unisexual generation of *A. atrimentus* on *Quercus lobata* have invariably been unsuccessful.

DISTRIBUTION.—Apparently throughout the range of the host plants from foothills of Coast Range and west slope of Sierras from Mendocino County to Mohave Desert border.

PLESIOTYPES.—American Museum of Natural History, New York; United States National Museum, Washington, D. C.; California Academy of Sciences, San Francisco; University of California at Davis; Weld collection, in possession of Robert J. Lyon, Los Angeles City College, Los Angeles, California.

LITERATURE CITED

- HOUARD, C. 1946. Les collections cecidologiques du laboratoire d'entomologie du Museum d'Histoire Naturelle de Paris: Galls des Etats-Unis et du Mexique. *Ann. Entomol. Soc. France*, 112: 25–26.
- KINSEY, A. C. 1922. New Pacific Coast Cynipidae. *Amer. Mus. Natur. Hist. Bull.*, 46: 279–280.
- ROSENTHAL, S. S. AND C. S. KOEHLER. 1971. Heterogony in some gall-forming Cynipidae with notes on the biology of *Neuroterus saltatorius*. *Ann. Entomol. Soc. Amer.*, 64(3): 565–570.
- WELD, L. H. 1957. Cynipid Galls of the Pacific Slope. Privately Printed, Ann Arbor, Mich. 64 p.

RECENT LITERATURE

ANIMALS OF THE ARCTIC. THE ECOLOGY OF THE FAR NORTH. Bernard Stonehouse. Holt, Rinehart and Winston, Inc., New York. 172 p., over 200 color photos. 1971. \$10.95.

This book is a non technical treatment of animal ecology in the Arctic with beautiful color illustrations, but with only brief references and illustrations of insects.—ROBBIN W. THORP, *University of California, Davis, 95616*.

THE CADDIS FLIES, OR TRICHOPTERA, OF ILLINOIS. Herbert H. Ross. Entomological Reprint Specialists, Los Angeles. 326 p., 961 figs., and preface to reprint edition by author. Reprinted 1972. \$9.95.

A reprint of Dr. Ross' classic faunal study of Trichoptera.—ROBBIN W. THORP, *University of California, Davis, 95616*.

A New Species of *Diplolepis* from California

(Hymenoptera: Cynipidae)

D. CHARLES DAILEY AND LINDA CAMPBELL

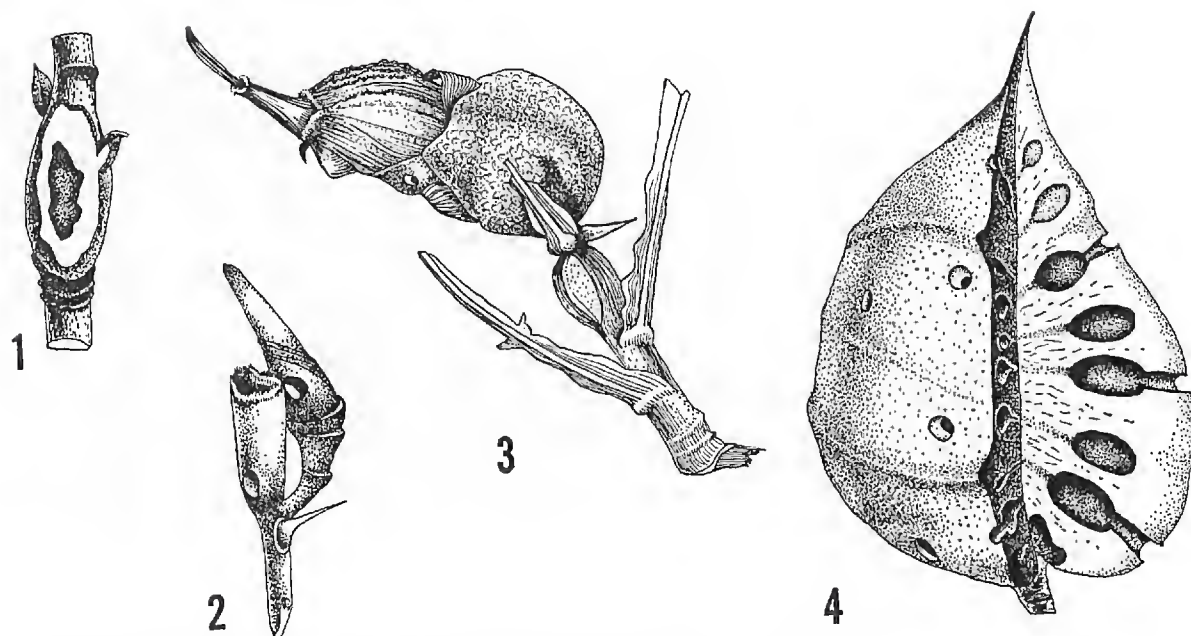
Sierra College, Rocklin, California 95677

A previously undescribed cynipid wasp from California, *Diplolepis inconspicuis* n. sp., produces an inconspicuous fusiform twig or bud gall on *Rosa californica* Chambers and Schlecht.

BIOLOGY.—The original gall is an inconspicuous fusiform enlargement of an apical or lateral stem or bud which yields a single adult *D. inconspicuis* in February or March (Figs. 1 & 2). After emerging, the female oviposits in a young stem or bud. If this gall is oviposited in by a female inquiline *Periclistus arefactus* McCracken and Egbert which emerge from old galls in the succeeding months, the new gall and gallmaker fail to develop normally (Fig. 3). The resulting enlarged, tan, woody to pithy, inquiline-modified gall bears lines which are aborted leaf margins and/or abscission scars of aborted leaflets (Fig. 4). It yields only inquilines and parasites. Because the inquiline-modified galls of *D. inconspicuis* closely resemble the normal galls of *D. arefacta* (Gillette) (1894), occurring from Colorado to Nevada, McCracken and Egbert (1922) mistakenly assumed this California gall was produced by *D. arefacta* and named the inquiline *Periclistus arefactus*. Weld's (1957) note on the inquiline-modified galls suggests the original gall was a single celled stem swelling subsequently modified by the inquiline. Our rearings have confirmed this.

***Diplolepis inconspicuis* Dailey and Campbell, new species**

HOLOTYPE FEMALE.—*Head*: Antennae black, 14 segmented; malar space 0.5 times eye height. *Thorax*: Mesoscutum coriaceous, pubescent; median groove smooth, one-third length of mesoscutum at scutellum as distinct and wide as notaulicities; notaulicities complete, pitted, slightly incurved at scutellum; scutellum entirely rugose, humped above extended curvature of mesoscutum, foveae ridged; mesopleuron with dorsal and ventral polished areas occupying about one-half and one-fourth of mesopleuron respectively, separated by mesolateral rugose area; wings with clouded radial area, radial cell closed, areolet about one-sixth length of cubital cell; cubital cell open proximally. Legs amber, tarsi brown, hind femur tapering suddenly near distal end. *Abdomen*: Propodeum rugose, first abdominal tergite polished coriaceous, sparsely pubescent medially; tergites II–VI progressively more coriaceous, pubescent posteriorly, abdomen equal to combined head and thorax length; hypopygium extending beyond abdomen. *Color*: Head and thorax black, abdomen red. *Length*: 3.9 mm.



FIGS. 1-4. Galls of *Diplolepis inconspicuis* n. sp. FIG. 1. Unaborted dissected stem gall. FIG. 2. Normal but broken stem gall and bud gall. FIG. 3. Immature inquiline aborted bud gall. FIG. 4. Mature inquiline aborted gall which yields *Periclistus arefactus*. All galls are shown twice life size.

Holotype female, and gall, MT. DIABLO, CONTRA COSTA COUNTY, CALIFORNIA C. Dailey #1204, emerged 12 February 1972. Deposited in U. S. National Museum.

Paratype females and galls, Folsom Lake, Placer County (2 ♀, 6 galls), Mt. Diablo, Contra Costa County, (10 ♀, 60 galls), Fairfield, Solano County, (4 ♀, 20 galls), Pleasant Valley, Solano County, (4 ♀, 29 galls), Marysville, Yuba County, (1 ♀, 115 galls), Sacramento, Sacramento County, (7 ♀, 12 galls). All specimens from California. Variation: Abdomen from 1.0 to 1.1 times combined head and thorax length. Length: 3.3 to 4.6 mm. Average of 10 specimens 3.9 mm.

SEX RATIO.—No males have been reared.

Paratype insects and galls are deposited in U. S. National Museum, Washington, D. C., California Academy of Science, San Francisco, California; Weld collection in possession of R. J. Lyon, Los Angeles, California; University of California, Davis; University of Saskatchewan, Saskatoon, Alberta, Canada; and the senior author's collection.

The galls of *D. inconspicuis* and *D. nodulosa* (Beutenmuller) (1909) are often indistinguishable though the latter are occasionally more spiny. The polished dorsal mesopleural area and longer hypopygium of *D. inconspicuis* females readily separate them from females of *D. nodulosa*, which have a small smooth dorsal mesopleural area and hypopygium not extending beyond the last abdominal segment.

ACKNOWLEDGMENTS

The authors are grateful to Mr. J. D. Shorthouse of the University of Saskatchewan for the loan of *D. nodulosa* insects and galls and Barbara Young for the illustrations.

LITERATURE CITED

- BEUTENMULLER, W. 1909. Descriptions of the new Cynipidae. *Entomol. News*, 20: 247.
- GILLETTE, C. P. 1894. New Cynipidae. *Can. Entomol.*, 26: 157.
- MCCRACKEN, I. AND D. EGBERT. 1922. California gallmaking Cynipidae with descriptions of new species. *Stanford Univ. Biol. Sci.*, 3: 62.
- WELD, L. H. 1947. *Cynipid Galls of the Pacific Slope*. Printed privately, Ann Arbor, Mich., 64 p.

BOOK REVIEW

BIOLOGICAL CONTROL. Edited by C. B. Huffaker. Plenum Press, New York. 511 p., 97 figs., 51 tables. 1971. \$19.50.

This book is a collection of papers presented by 33 contributors to a symposium of the Ecological Society of America and the Association for the Advancement of Science in December 1969. Each of the 20 papers is treated as a chapter with its own bibliography. These chapters are arranged in four sections. The book terminates with a complete index to all authors cited in the text of each paper including secondary authors, and a complete subject index.

The first five chapters (Section 1) deal with the theory and evaluation of biological control including: the "Pesticide Syndrome" and its remedy through integrated control; the role of natural enemies in natural control; the adaptability of introduced parasitoids; models, life tables and experimental techniques for evaluating natural enemies.

Chapters 6-10 (Section 2) discuss recent successful examples of biological control of weeds, coccids, greenhouse pests, and the winter moth in Canada. The emphasis is on recent examples so some of the better known examples of weed and pest insect control (e.g. *Opuntia* in Australia, Klamath weed and cottony cushion scale in California) are omitted.

Chapters 11-13 (Section 3) treat examples of naturally-occurring biological control in America north of Mexico, in natural and agricultural ecosystems. The recent appreciation of naturally-occurring biological control is an important development in pest management thinking.

Section 4 (Chapters 14-20) considers the role of biological control in a systems approach to pest control. The majority of these chapters discuss the development of various integrated control programs.

This book is a well balanced treatment of documented examples and the theory of biological control with an emphasis on the role of biological control in integrated control programs. Since integrated control had its inception in California, it is appropriate that about half of the authors are associated with campuses of the University of California. The book is an outstanding reference on the theory and practice of applied ecology in pest management.—ROBBIN W. THORP, *University of California, Davis, 95616*.

Thomas Wrentmore Cook (1884–1962)

PAUL H. ARNAUD, JR. AND MARY MANNING WALE

California Academy of Sciences, San Francisco, 94118, and 5933 Camden Street, Oakland, California 94605

Thomas Wrentmore Cook was born on 6 December 1884 in Sydney, Australia, and died in Oakland, California on 17 February 1962. He was the eldest of the four children of George Wrentmore Cook and Sarah Helsby Cook. His paternal grandfather, Edward Wrentmore Cook, born in Somersetshire, emigrated to Australia in the 1850's and eventually built up a large bakery business in Sydney. Dr. Cook's maternal grandmother, née Jane Hutton, came from Cambridge, England. She was the daughter of a cabinet maker who responded to the British government's efforts to bring skilled craftsmen to Australia. The family then made the six months' voyage around the Cape of Good Hope. In Sydney Jane met Thomas Helsby, a native of Lancashire and they were married. The young bridegroom followed the trade of stone mason; ultimately he became a building contractor.

Thus, at the time of his birth Dr. Cook was a second generation Australian, something relatively rare in the year 1884. He attended Sydney Technical High School where he studied drafting, but at the insistence of his Grandfather Helsby (who had little use for book learning) began and completed a five-year apprenticeship as a machinist and instrument maker. This was a bitter blow to the sixteen year old boy who already had intellectual aspirations. His interest in natural history was also very strong and had been so since earliest childhood. A period spent in Brisbane when he was between twelve and fourteen years of age was especially influential in this respect. The sub-tropical environment, the proximity to the Great Barrier Reef, the beautiful and exotic birds—sulphur-crested cockatoos, budgerigars, and such—left an imprint vividly felt throughout his life.

After completing the above-mentioned apprenticeship Dr. Cook worked for six months in the Fiji Islands, helping to construct a sugar mill. Again, his surroundings were of intense interest. The East Indians who made up the work force, the native Fijians, the tropical environment all stimulated his curiosity. He returned briefly to Sydney, then once more set out to see the world after the fashion of so many adventurous young men. Hearing that there was a great demand for machinists in San Francisco, then rebuilding after the earthquake of 1906, he took



FIG. 1. Thomas Wrentmore Cook. Photograph taken in 1933.

passage for that city, arriving 18 April 1907. Twenty dollars (hidden in a money belt), the clothes he was wearing, and a book on shells were his sole possessions. Everything else had been stolen aboard ship.

As things turned out Dr. Cook ended up working in Salinas at the Spreckels Sugar Mill instead of in San Francisco, simply because he heard of immediate job openings there. It was in Salinas that he met and married Mary Jensen. This marriage ended in divorce in 1922.

He acquired U. S. citizenship in 1912 and during the First World War was at the Naval Ship Yard, Vallejo, California. Following this Dr. Cook was employed as an instrument maker by the University of California, Berkeley, working for various scientists, but particularly for the Engineering Department. He had unusual manual dexterity and from rough two-dimensional sketches could visualize objects in three dimensions.

At this point a member of his family offered to finance his way through dental school. Dr. Cook was not especially keen about dentistry, but saw this as a means of accomplishing his long held ambition of attending college. For some time he had been taking night classes in order to prepare himself for the entrance examinations to the University. He passed the matriculation examination and in 1922 received his D. D. S. degree from the University of California, winning membership in the dental honor society. He was given a post as dental surgeon at the University's Cowell Hospital in Berkeley; at the same time he opened a private practice in Berkeley. He also attended classes in anthropology at the University. This was a subject which had long interested him, probably having its inception in contacts as a youth with Australian aborigines. The unusual energy and drive possessed by Dr. Cook are shown in his ability to carry on all of these activities simultaneously.

He received a B. A. in 1925 and an M. S. in 1926, degrees in physical anthropology. His Master's thesis, based upon observation of University students, was entitled "Dental Arches; a Study in Dento-Physical Anthropology."

Later, Dr. Cook also began taking courses in entomology with Professor E. O. Essig at the University of California, Berkeley. In the early 1930's he moved to Davis where he continued to follow the practice of dentistry. He enrolled at this branch of the University of California, completing his B. S. degree in entomology in 1932 under the direction of Professor W. B. Herms. He then went to Harvard University, commencing graduate studies involving the ants of California, under Dr. William Morton Wheeler. This period at Harvard was dis-

appointing because he did not receive the kind of guidance he had expected.

In the spring of 1933 he moved to Washington, D. C. and began working on a problem in physical anthropology at the Smithsonian Institution under the general guidance of Gerrit S. Miller. The fruit of this labor appeared in an article, "The Human Chin and Human Tooth Change" (1933, *Int. J. Orthodont. Dent. Child.*, 19: 730-734).

In Washington Dr. Cook met Mary Barbara Manning, then on the staff of the Library of Congress. They were married on 19 April 1933 and began a journey to Australia, visiting England—the land of his ancestors, and France. In Marseilles they boarded a ship for the six weeks' voyage to Sydney. There were brief stops at Port Said, Colombo, and Melbourne, where they visited the Museum and viewed the natural history collection.

Plans for settling in Sydney where Dr. Cook's mother and brother lived were changed because of the depressed economic conditions in Australia and the length of time it would have taken to obtain a dental license. In the fall of 1933 he returned to Berkeley and resumed his dental practice. At this time, following his insatiable desire for knowledge he began taking courses at the Pacific School of Religion. He had long been interested in William Frederick Badé, the renowned authority on the Old Testament, and was eager to attend his lectures. Dr. Cook also took courses with Theodore McCown and James Muilenberg and finally completed the requirements for the degree of Bachelor of Theology in 1939. The title of his thesis was "A Study of Some of the Universal Religious Tendencies in Pre-Literate Man; a Problem in Anthropology." The thesis included the case history of Crashing Thunder, a young Indian boy, and his initiation into the Peyote cult, antedating by several years the current interest in psychedelic drugs.

Because of the Depression dentistry was bringing in just a bare living and America's defense efforts seemed to hold more possibility for financial security. Accordingly Dr. Cook took a civil service position as instrument maker with the U. S. Government. In August 1941 he sailed for Hawaii, with the idea of having his family follow at a later date, and was assigned duty at Pearl Harbor Navy Yard. He was working there on the fateful day of December 7th but escaped injury except for some fragments of metal striking his eye. Civilian workers were frozen to their jobs and it was two years before he could obtain a release to return to the mainland and rejoin his family. Meanwhile he was transferred from the Navy to the Corps of Army Engineers which had its headquarters at Punahou School. He greatly enjoyed the chal-

lenge to his ingenuity posed by the task of improvising all sorts of equipment which could not be obtained from the mainland.

Late in 1943 after Dr. Cook's return to the Bay Area he recommenced the practice of dentistry with great success. By the time he had reached the age of seventy he was semi-retired but carried on a limited practice at his residence. In March 1961 he suffered a mild stroke, the harbinger of the massive strokes causing his death on 17 February 1962. Until three weeks before his decease he had a clear, active mind and was still interested in his many fields of knowledge.

It was about 1948 that Dr. Cook decided to put into book form the data he had gathered on California ants. The better part of five years was spent completing his volume entitled *The Ants of California*. Privately published in 1953, it consists of 462 pages and 94 illustrations. The drawings for the illustrations were made by Marian A. Kendall.

During the last fourteen years of his life Dr. Cook concentrated on assembling a highly specialized library on the ants of the world. He had bound in 51 volumes a virtually complete set of the publications of William Morton Wheeler. His collection of books on entomology as indicated in a note by Arnaud (1972, Pan-Pac. Entomol., 48: 63) was donated to the California Academy of Sciences by his widow. Dr. Cook's collection of 4,397 pinned specimens of ants, 213 vials of ants (uncounted as to number) and 27 Schmitt boxes of miscellaneous insects was donated to The Oakland Museum in 1964. The ants were transferred to the Los Angeles County Museum of Natural History, Los Angeles in 1971.

Dr. Cook is survived by his widow Mary Manning Cook (now Mrs. George Wale), and two children from this marriage, Thomas Manning Cook of Berkeley and Barbara Wrentmore Cook (Mrs. Gilbert Barnes) of Indianapolis. From his first marriage he is survived by two sons, Donald Wrentmore Cook of San Marino, California, and Ralph A. Cook of Salinas, California. He is also survived by five grandchildren and two great grandchildren.

Thus ended the career of a versatile, many-sided man who was above all a naturalist.

SCIENTIFIC NOTES

A Biological Note on Two Species of *Ageniella* from California (Hymenoptera:Pompilidae).—Very little information is available on any aspect of behavior for members of the nominate subgenus of *Ageniella*. The prey records and fragmentary nesting information given here for two western species are thus of considerable interest. On 24 October 1966, Wasbauer found a female *Ageniella blaisdelli* (Fox) on a small, isolated bank of bare, consolidated sand on the Sacramento River levee near Sacramento, California. The bank had a nearly vertical face toward the river, about fifteen feet from the water. It was surrounded by cottonwood trees (*Populus fremontii*), short grass and a stand of California mugwort (*Artemisia vulgaris* var. *heterophylla*). When first seen at about 1:00 p.m., Pacific Daylight Time, the wasp was on the top of the bank, moving rapidly with characteristic wing twitching and investigating burrow entrances presumably of other Hymenoptera. It ran under a fallen cottonwood leaf at the base of the bank and proceeded immediately to a burrow entrance near the top of the vertical face. It entered the burrow, remained ten minutes and then repeated the procedure, remaining in the burrow twenty minutes. As it left, a female *Astata occidentalis* Cresson (Det. R. M. Bohart) entered the burrow, without prey, remained only a matter of seconds and flew off. In the meantime, the *Ageniella* female had returned to the cottonwood leaf and pulled a paralyzed spider from under it. It alternately ran and flew in short hops directly to the burrow entrance, four feet away. Its progress was so rapid that the manner of prey transport could not be ascertained. It deposited the spider just outside the entrance, entered, reappeared head first and pulled the spider in by the end of the abdomen. It had been inside the burrow about five minutes when the *Astata* returned, again without prey. Both wasps were collected shortly thereafter, as they left the burrow. On excavation, the burrow which was 1 cm in diameter, was found to enter the soil at a 45° angle. It was straight for 15 cm and was not traced further. At 1.3 cm in from the entrance was a horizontal lateral burrow which extended 2.5 cm and terminated in a slightly enlarged cell, 1.2 cm long. The cell had not been closed. The spider found in the cell was an immature *Pardosa* sp. (Lycosidae) (Det. R. Leech) with all of its legs amputated at the coxae, except the right anterior which was severed near the apex of the tibia. A wasp egg was not found.

Another female of *Ageniella blaisdelli* was found by Leech at Stove Pipe Campground, 6100 feet, in the Chowchilla Mountains, Mariposa County, California, on 6 August 1971. It was dragging a spider across a dusty Forest Service road in mid-afternoon in full sunlight. The spider, in this case, was an immature female lycosid, *Tarentula* sp. prob. *kochi* (Keyserling) (Det. R. Leech). All eight legs had been amputated at the coxae.

There is a female of *Ageniella* (*A.*) *coronata* Banks in the collection of the California Academy of Sciences, pinned with a female clubionid spider, probably *Liocranoides* sp. (Det. R. Leech). All the legs of this spider had been amputated. The label reads only "Mendocino Co. Cal. VII-20-23. E. R. Leach." Almost all insects similarly labeled by the late Edwin R. Leach were actually taken at the junction of Yale Creek with Rancheria Creek, about two miles south of the old site of Yorkville Post Office on Route 28 (i.e., some 14 airlines miles northwest of Cloverdale).

Evans [1969, Entomol. Soc. Amer. Misc. Publ., 3: 107-108] has summarized

the published biological information on Nearctic species of *Ageniella*. He states that two members of the subgenus *Ageniella*, *A. accepta* (Cresson) and *A. conflicta* Banks, both closely related to *A. blaisdelli*, seek out natural crevices in the soil and that *A. accepta* is reported to dig a short burrow from a crevice. Thus it is likely that all three species in this group, and possibly all Nearctic species in the subgenus *Ageniella*, normally nest in such situations.—MARIUS S. WASBAUER, *California Department of Agriculture, Sacramento, 95814*; AND HUGH B. LEECH, *California Academy of Sciences, San Francisco, 94118*.

Recent Annoyance to Man in Utah by *Triatoma protracta* (Hemiptera: Reduviidae).—In the southwestern United States conenose bugs, *Triatoma* and *Paratriatoma*, feed predominantly upon the blood of wild mammals, but will also feed upon human blood. Allergic reactions to their feeding vary from barely perceptible local disturbances at the site to severe systemic reactions (James and Harwood, 1969, *Herm's Medical Entomology*, 6th Ed. 131–132). Their role as vectors of sylvatic *Trypanosoma cruzi* Chagas in mammals is well established but their ability to transfer it to man is questionable. Naturally infected *Triatoma p. protracta* (Uhler) have been reported in Utah from Kane County (Wood, 1956, *Bull. S. Calif. Acad. Sci.*, 55: 180) and Wayne County (Ryckman, 1962, *Univ. Calif. Publ. Entomol.*, 27: 115).

In 1965 a 60 year old man living near Springdale, Washington County, contacted me for information concerning treatment for his severe hypersensitivity to bites of *Triatoma*. Local and systemic reactions to the salivary injections of the triatomines necessitated repeated treatments by resident physicians. Since the original inquiry, he has reported at least 20 bite reactions of varying severity 7, 3, 1, 1, 5, and 3 times per year successively from 1966 through 1971. These occurred during the summer periods of active dispersal of the insects. His tabulation of bite sites indicates this subspecies feeds on any exposed area of the body. The wife either was not fed upon by *Triatoma* or did not react to the bites.

The home, situated on a hill, at an elevation of 1,219 m, produced 19 males, 29 females and 2 fifth instar nymphs of *T. p. protracta* during the six year period. The nymphs indicate a nearby colonizing site. This was probably a rock wall in front of the house since the home was on an intact concrete slab and there was no opportunity for triatomines to come up through the floor as at the San Joaquin Experimental Range in California (Wood, 1951, *Bull. S. Calif. Acad. Sci.*, 50: 106). The yearly totals for 1966 through 1971 were 15, 7, 12, 1, 9, and 6 with monthly totals for May through October of 3, 8, 15, 14, 9, and 1. The months of greatest annoyance were July and August. For 1966 through 1968, two cats may have been attractants since the larger number of bugs (34) was collected inside the home during this time. From 1969 through 1971 without cats, the same person collected 16 triatomines inside the home. From 1966 through 1968, the number of bite reactions was 11 and from 1969 through 1971, 9. Most bugs fed at night. One fed by day on 2 August 1966 resulting in "3 bites on the back" while resting on the sofa in the living room.

Locations of capture for 43 of 50 triatomines received revealed a 30:8:5 ratio for bedroom (10♂, 18♀, 2 fifth instar nymphs), living room (4♂, 4♀), kitchen (2♂, 3♀) complex as compared with a 14:2:3 ratio for 40 *T. p. protracta* at the SJER. Time of capture included 3 at dawn, 17 in daylight, 2 at dusk and 20 at night.

The recta of 48 triatomines (21 ♂, 25 ♀, 2 fifth instar nymphs) were removed by me and crushed in sodium citrate solution for examination for trypanosomes. Forty-five samples were negative and three were positive. Chagas' trypanosome was found in the feces of 2 ♀ collected 8 and 23 July 1970 and 1 ♂ 30 September 1971 when examined 4 to 6 days after capture. Since all trypanoform (trypomastigote) and crithidiform (epimastigote) parasites appeared dead, no attempt was made to infect laboratory mice. Springdale, therefore, constitutes a new locality for occurrence of Chagas' zoonosis in Utah. Of a total of 110 *Triatoma p. protracta* examined by me from various localities in Utah to 1972, 5 or 4.5% were infected.—SHERWIN F. WOOD, *Los Angeles City College, Los Angeles, California 90029*.

BOOK REVIEW

INSECT VISION. G. A. Mazokhin-Porshnyakov. Translated from the Russian by R. and L. Masironi. Translation edited by T. H. Goldsmith. Plenum Press, New York. 306 p., 125 figs., 29 tables. 1969. \$22.50.

This translation is an important contribution to our knowledge of insect vision, especially in its treatment of the author's own works and other Russian literature not readily available to English speaking scientists. Originally published in 1958, the author revised and updated the book for the English translation.

The book starts with considerations of the structure and neurology of compound eyes, then discusses the theories of mosaic versus diffraction image formation. Other chapters treat the photomechanical phenomena, electrical responses, resolving power, and perception of polarized light and color by compound eyes, the structure and function of ocelli, light orientation, and ultraviolet perception.

This monograph presents a fascinating and thought provoking coverage of visual physiology in insects and will remain a standard reference in this field.—ROBBIN W. THORP, *University of California, Davis, 95616*.

EDITORIAL NOTICE

The editorship of the *Pan-Pacific Entomologist* will change hands beginning with the July 1973 issue (Vol. 49, No. 3). New manuscripts should be submitted to Dr. John Doyen, Division of Entomology, University of California, Berkeley, California 94720.

INSECT PINS

\$4. / 1000 (10 Pkgs.)

(Plus Postage)

PROMPT DELIVERY

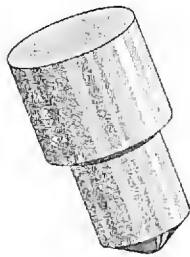
CLAIR ARMIN
191 W. Palm Avenue
Reedley,
California 93654

LOWEST PRICES IN AMERICA

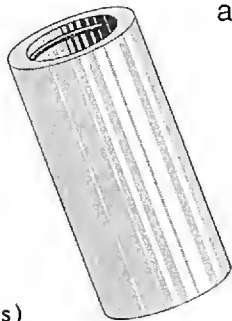
ARTHROPOD MICROVIALS

DESCRIPTION

Semitransparent polyethylene vials with silicone rubber stoppers for use in storage of insect genitalia and other small arthropod parts where association with a pinned specimen or location of small parts in alcohol storage is desirable.



Drawing
4 times
actual
size
(approx.)



ADVANTAGES

- Glycerine will not creep up sides of vial
- Impervious and non-reactive to glycerine, alcohol and other common storage reagents.
- Will not corrode insect pins
- Unbreakable
- Uniform size
- Ideal for class use
- Available at once in two standard sizes

PRICE (Includes Stoppers)

	1000	500
LARGE	\$50.00	\$30.00
SMALL	45.00	28.00

F. O. B. SACRAMENTO

SPECIFICATIONS

LARGE

SMALL

Vial Outside Diameter..... 7/32" (6mm.) 5/32" (4.5mm.)

Vial Length w/Stopper..... 5/8" (16mm.) 9/16" (14mm.)

(Special sizes are available - write for information)

ARTHROPOD SPECIALTIES CO.

P. O. BOX 1973 • SACRAMENTO, CALIFORNIA 95809

COMMERCIAL AND RESEARCH ENTOMOLOGISTS

Obtain more accurate population counts
with a light-weight motor-fan unit
which sucks insects into nets

D-VAC
MOTOR-FAN VACUUM INSECT NETS
BACK-PACKS AND HAND MODELS

-also-

BENEFICIAL INSECTS
INSECTARY GROWN AND FIELD COLLECTED
Trichogramma sp. and Green Lacewings

Write for Brochures

D-VAC CO.
P. O. Box 2095
RIVERSIDE, CALIFORNIA

ENTOMOLOGICAL EXCHANGES AND SALES

Space is available to members and non-members who wish to advertise entomological exchanges, sales, announcements, etc. We can offer an ad in four issues for \$1.50 per line. Ads will be arranged in order of their receipt. Contact the Advertising Manager, W. H. Lange, Department of Entomology, University of California, Davis, California 95616.

FOR SALE. Extensive collection of mayfly reprints. Write R. Brusca, Department of Biology, University of Arizona, Tucson, 85721.

FOR SALE. Over 900 species of butterflies from the Malaysian and Indonesian Jungles, very rare moth (14" wing span), Scorpion, giant sized Indonesian flying lizard, centipedes, stick insects, all types of rhinoceros beetles and rare beetles in the families Scarabaeidae, Lucanidae, Mordellidae, Cerambycidae, etc. Write Sim Yam Seng, 21, Joon Hiang Road, Singapore, 19, Singapore.

THE PAN-PACIFIC ENTOMOLOGIST

Information for Contributors

Papers on the systematic and biological phases of entomology are favored, including articles up to *ten* printed pages on insect taxonomy, morphology, behavior, life history, and distribution. Excess pagination must be approved and may be charged to the author. Papers are published in approximately the order that they are received. Immediate publication may be arranged *after* acceptance by paying publication costs. Papers of less than a printed page may be published as space is available, in SCIENTIFIC NOTES.

Manuscripts for publication, proof, and all editorial matters should be addressed to the *Editor*, Robbin W. Thorp, Department of Entomology, University of California, Davis, California 95616.

Typing.—All parts of manuscripts must be typed on bond paper with double-spacing and ample margins. Carbon copies or copies on paper larger than $8\frac{1}{2} \times 11$ inches are not accepted. Do not use all capitals for any purpose. Underscore only where italics are intended in the body of the text, not in headings. Number all pages consecutively and put author's name at the top right-hand corner of each sheet. References to footnotes in text should be numbered consecutively. Footnotes should be typed on a separate sheet.

First page.—The page preceding the text of the manuscript should include (1) the complete title, (2) the order and family in parentheses, (3) the author's name or names, (4) the institution with city and state or the author's home city and state if not affiliated, (5) the shortened title (running headline) not to exceed 38 letters and spaces when combined with the author's last name or names, (6) the complete name and address to which proof is to be sent.

Names and descriptions of organisms.—The first mention of a plant or animal should include the full scientific name with the author of a zoological name *not* abbreviated. Do not abbreviate generic names. Descriptions of taxa should be in telegraphic style.

References.—All citations in text, e.g., Essig (1926) or (Essig, 1958), should be listed alphabetically under LITERATURE CITED in the following format:

Essig, E. O. 1926. A butterfly migration. *Pan-Pac. Entomol.*,
2: 211-212.

1958. *Insects and mites of western North America*. Rev.
ed. The Macmillan Co., New York. 1050 pp.

Abbreviations for titles of journals should follow the list of *Biological Abstracts*, 1966, 47(21): 8585-8601.

Tables.—Tables are expensive and should be kept to a minimum. Each table should be prepared as a line drawing *or* typed on a separate page with heading at top and footnotes below. Number tables with Arabic numerals. Number footnotes consecutively for each table. Use only horizontal rules.

Illustrations.—No extra charge is made for the line drawings or halftones. Submit only photographs on glossy paper and original drawings (no photographs of drawings). Authors *must plan* their illustrations for reduction to the dimensions of the printed page ($4\frac{1}{8} \times 6\frac{3}{4}$ inches). If possible, allowance should be made for the legend to be placed beneath the illustration. Photographs should not be less than the width of the printed page. Drawings should be in India Ink and at least twice as large as the printed illustration. Excessively large illustrations are awkward to handle and may be damaged in transit. Include a metric scale on the drawing or state magnification of the *printed* illustration in the legend. Arrange figures to use space efficiently. Lettering should reduce to no less than 1 mm. *On the back of each illustration* should be stated (1) the title of the paper, (2) the author's complete name and address, and (3) whether he wishes the illustration and/or cut returned to him *at his expense*. Cuts and illustrations not specifically requested will be destroyed.

Figure legends.—Legends should be typewritten double-spaced on separate pages headed EXPLANATION OF FIGURES and placed following LITERATURE CITED. Do not attach legends to illustrations.

Proofs, reprints, and abstract.—Proofs and forms for the abstract and reprint order will be sent to authors. Major changes in proof will be charged to the author. Proof returned to the editor without the abstract will not be published.

Page charges.—All regular papers of one to ten printed pages are charged at the rate of \$18.00 per page. This is in addition to the charge for reprints and does not include the possible charges for extra pagination or the costs for immediate publication. Private investigators or authors without institutional or grant funds to cover this charge may apply to the Society for a grant to cover the page charges. A mark in the appropriate box (society grant desired) on the reprint order form will suffice as an application.

All articles are accepted for publication *only* on the basis of scientific merit and without regard to the financial support of the author.

**PUBLICATIONS
OF THE
PACIFIC COAST ENTOMOLOGICAL SOCIETY**

PROCEEDINGS OF THE PACIFIC COAST ENTOMOLOGICAL SOCIETY.

Vol. 1 (16 numbers, 179 pages) and Vol. 2 (numbers 1-9, 131 pages). 1901-1930. Price \$2.50 per volume.

PAN-PACIFIC ENTOMOLOGIST.

Vol. 1 (1924) to present. Price \$10.00 per volume of 4 numbers, or \$2.50 per single issue.

MEMOIR SERIES.

Volume 1. *The Sucking Lice* by G. F. Ferris. A 320-page book which summarizes the knowledge of the Anoplura of the world. Published October 1951. Price \$6.00. (Plus 35¢ postage.)*

Volume 2. *The Spider Mite Family Tetranychidae* by A. Earl Pritchard and Edward W. Baker. This worldwide treatment deals with the systematics, identification, and economics of the "Red Spiders" and includes descriptions of 33 new species. 472 pages. Published July 1955. Price \$10.00. (Plus 50¢ postage.)*

Volume 3. *Revisionary Studies in the Nearctic Decticinae* by David C. Rentz and James D. Birchim. This 173-page revision of Nearctic shield-back katydids includes descriptions of one new genus and 13 new species and subspecies. Published July 1968. Price \$4.00. (Plus 25¢ postage.)*

Volume 4. *Autobiography of an Entomologist* by Robert L. Usinger. A 343 page book relating the life story of one of the outstanding entomologists of our time. Published August 1972. Price \$15.00. (Plus 40¢ postage.)*

* (Add 5% sales tax on all California orders. Members of the Society will receive a 20% discount.)

Send orders to:

Pacific Coast Entomological Society
c/o California Academy of Sciences
Golden Gate Park
San Francisco, California 94118

THE PAN-PACIFIC ENTOMOLOGIST



DOUTT—The genus <i>Paranaphoidea</i> Girault (Hymenoptera: Mymaridae)	185
DAILEY AND SPRENGER—Synonymy of <i>Andricus gigas</i> and the bisexual generation of <i>Andricus crenatus</i> (Hymenoptera: Cynipidae)	188
DOUTT—The genus <i>Paratrichogramma</i> Girault (Hymenoptera: Trichogrammatidae)	192
SLOBODCHIKOFF—Behavioral studies of three morphotypes of <i>Therion circumflexum</i> (Hymenoptera: Ichneumonidae)	197
WHEELER AND WHEELER—The ant larvae of the tribes Basicerotini and Dacetini: second supplement (Hymenoptera: Formicidae: Myrmicinae)	207
DOUTT—The genus <i>Polynemoidea</i> Girault (Hymenoptera: Mymaridae)	215
DOUTT—The fossil Mymaridae (Hymenoptera: Chalcidoidea)	221
GREGARICK, SCHUSTER AND TOFTNER— <i>Macrobiotus montanus</i> from California (Tardigrada: Macrobiotidae)	229
GRISSELL—New species of North American Torymidae (Hymenoptera)	232
BROWN AND ALLEN—A new <i>Comadia</i> from the San Joaquin Valley of California (Lepidoptera: Cossidae)	240
BENEDETTI—Notes on the biology of <i>Neomachilis halophila</i> on a California sandy beach (Thysanura: Machilidae)	246
ADAMS—Coniopterygidae from Chile, with three new species (Neuroptera)	250
CHANDLER AND NUTTING—A new species of <i>Hamotus</i> from galleries of <i>Microcerotermes septentrionalis</i> in western Mexico (Coleoptera: Pselaphidae) (Isoptera: Termitidae)	255
GREGARICK, SCHUSTER AND TOFTNER—Descriptive morphology of eggs of some species in the <i>Macrobiotus hufelandii</i> group (Tardigrada: Macrobiotidae)	258
MILLER—Mealybugs of San Miguel Island, California (Homoptera: Coccoidea: Pseudococcidae)	264
GARDNER—A new milliped of the genus <i>Tynomma</i> from California (Lysiopetalidea: Lysiopetalidae)	270
AYALA—Two new subspecies of the <i>Drosophila willistoni</i> group (Diptera: Drosophilidae)	273
SCIENTIFIC NOTES	196, 257, 279
BOOK REVIEWS	228, 239, 280-283
BOOK NOTICE	245
RECENT LITERATURE	191, 206, 220, 249

SAN FRANCISCO, CALIFORNIA • 1973

Published by the PACIFIC COAST ENTOMOLOGICAL SOCIETY
in cooperation with THE CALIFORNIA ACADEMY OF SCIENCES

THE PAN-PACIFIC ENTOMOLOGIST

EDITORIAL BOARD

J. T. DOYEN, *Editor*

J. A. CHEMSAK, *Asst. Editor*

P. H. ARNAUD, JR., *Treasurer*

E. G. LINSLEY

E. S. ROSS

H. V. DALY

H. B. LEECH

Published quarterly in January, April, July, and October with Society Proceedings appearing in the January number. All communications regarding nonreceipt of numbers, requests for sample copies, and financial communications should be addressed to the Treasurer, Dr. Paul H. Arnaud, Jr., California Academy of Sciences, Golden Gate Park, San Francisco, California 94118.

Application for membership in the Society and changes of address should be addressed to the Secretary, Mr. Michael R. Gardner, 131 Aspen Drive, Pachecho, California 94553.

The annual dues, paid in advance, are \$7.50 for regular members of the Society, \$5.00 for student members, or \$10.00 for subscriptions only. Single copies are \$2.50 each or \$10.00 a volume. Make checks payable to *Pan-Pacific Entomologist*.

The Pacific Coast Entomological Society

OFFICERS FOR 1973

J. A. CHEMSAK, *President*

PAUL H. ARNAUD, JR., *Treasurer*

C. B. PHILIP, *President-elect*

MICHAEL R. GARDNER, *Secretary*

STATEMENT OF OWNERSHIP

Title of Publication: The Pan-Pacific Entomologist.

Frequency of Issue: Quarterly (January, April, July, October).

Location of Office of Publication, Business Office of Publisher, Publisher and Owner: Pacific Coast Entomological Society, California Academy of Sciences, Golden Gate Park, San Francisco, California 94118.

Editor: Dr. John T. Doyen, Division of Entomology & Parasitology, University of California, Berkeley, California 94720.

Managing Editor and Known Bondholders or other Security Holders: None.

This issue mailed 19 October 1973

Second Class Postage Paid at San Francisco, California and additional offices.

ALLEN PRESS, INC.

PRINTED
IN
U.S.A.

LAWRENCE, KANSAS

The Pan-Pacific Entomologist

VOL. 49

JULY 1973

No. 3

The Genus *Paranaphoidea* Girault

(Hymenoptera: Mymaridae)

RICHARD L. DOUTT¹

University of California, Berkeley

Girault twice described *Paranaphoidea* as a new genus; first in 1913, and then curiously without explanation again in 1914. Students of the Mymaridae have been misled by his descriptions, for this resulted in the wrong placement of the genus in the subfamily Mymarinae by Annecke and Doutt (1961). The two subfamilies of Mymaridae are differentiated fundamentally by the manner in which the abdomen and thorax are joined. In the Alaptinae the mesophragma projects strongly into the abdomen which is sessile and broadly joined to the thorax. It is otherwise in the Mymarinae to which *Paranaphoidea* presumably belonged on the basis of Girault's statements such as "phragma apparently absent," "like *Anaphoidea*," and "This genus, for the present, I consider allied with *Anaphoidea*" (Girault, 1914). His choice of the name *Paranaphoidea*, of course, further suggested that the two genera were closely related.

For years no one saw Girault's specimens, he published no illustrations, and his word descriptions were obviously inadequate. Apparently this caused Ogloblin (1935) also to misinterpret the genus when he described *Paranaphoidea silvana* and *P. clavata*. These two species seem better placed in *Patasson*, which is now the proper name for *Anaphoidea*.

Through the courtesy of E. C. Dahms, Curator of Entomology at the Queensland Museum, I have had the opportunity to study there the Girault types. *Paranaphoidea* clearly belongs in the subfamily Alaptinae. The mesophragma is well developed and strongly projects into the abdomen which is sessile and broadly joined to the thorax. The tarsi are 4-segmented so the genus is in the tribe Anagrini according to the classification proposed by Annecke and Doutt (1961). The venation is much like that of *Stethynium* which is a member of the same tribe. The posterior wings are very broad for the family, nearly

¹ Present address: 9240 S. Riverbend Avenue, Parlier, Ca. 93648.

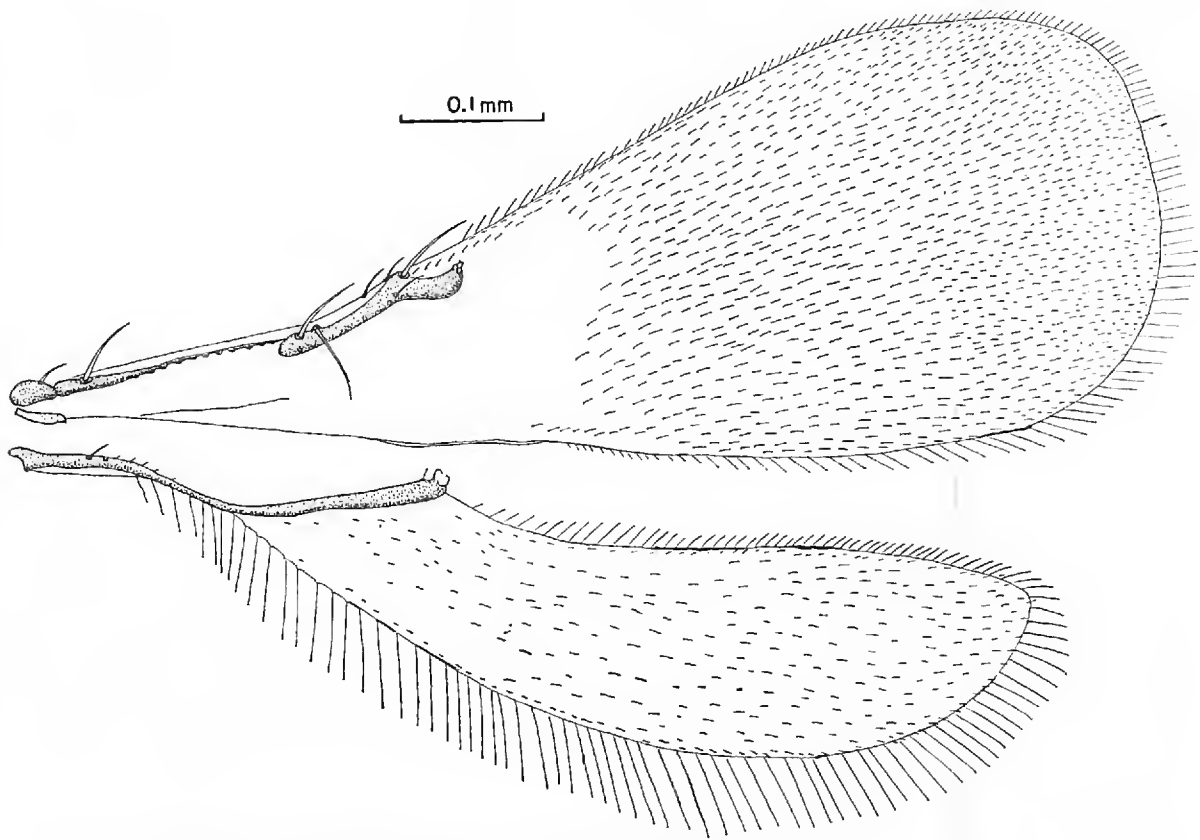


FIG. 1. Wings of *Paranaphoidea densiciliata* Girault.

like those in the Eulophidae yet distinctly pedicellate at base (Fig. 1). Contrary to Girault's description the strigil is present. The ovipositor is strongly developed, and in some species the valvifers extend far forward beneath the thorax in a membranous pouch. The antennae are inserted close to the inner margins of the compound eyes about the middle of the face. The scape and pedicel of the female antennae are comparatively short; in some species the scape is serrated but smooth in others; the funicle is 6-segmented; the club 2-segmented. The forewings are somewhat truncate apically, the marginal fringes short, the discal cilia entirely lacking beneath the sinuate venation.

The most extraordinary species is *P. elongata* which Girault (1923) in a very curious, privately published paper described as "the largest known Mymarid." It does possess an exceptionally elongate abdomen and a tremendously long ovipositor for a Mymarid, and all of its characters such as tarsomeres, flagellomeres and even its wing venation seem abnormally elongated.

The type species is *P. egregia* Girault from which Girault seems to have separated the species *P. caudata* and *P. intermedia* on little more than color differences. In an unpublished manuscript Girault indicated that *Anaphoidea harveyi* Girault belongs to this genus.

The genus is presently constituted as follows, although the proper

status of *P. caudata* and *P. intermedia* deserves further study and the correct inclusion of *P. harveyi* and *P. nigriclava* needs confirmation.

PARANAPHOIDEA Girault

Paranaphoidea Girault, 1913. Mem. Queensland Mus., 2: 115.

Paranaphoidea Girault, 1914. Proc. Entomol. Soc. Wash., 16(2): 112.

TYPE.—*Paranaphoidea egregia* Girault. Orig. desig.

auripes Girault, 1925. Some gem-like or marvellous inhabitants of the woodlands heretofore unknown and by most never seen nor dreamt of. Privately publ., 3 pp., p. 2. (Type: Mulgowie, Queensland).

caudata Girault, 1915. Mem. Queensland Mus., 3: 161. (Type: Cooktown, Queensland).

densiciliata Girault, 1938. Rev. Entomol., 9: 391. (Type: Canterbury, Victoria).

densiciliata nostra Girault, 1938. Rev. Entomol., 9: 391. (Type: Chinchilla, Australia).

egregia Girault, 1913. Mem. Queensland Mus., 2: 115. (Type: Nelson, Queensland).

elongata Girault, 1923. Loves Wooded and Won in Australia. Privately publ. 3 pp., p. 2. (Type: Wynnum, Australia).

eucalypti Girault, 1925. Insec. Insc. Menstr. 13: 94 (Type: Banyo, Queensland).

harveyi (Girault).

Anaphoidea harveyi Girault, 1912. Mem. Queensland Mus., 1: 151–152. (Type: Nelson, Queensland).

intermedia Girault, 1915. Mem. Queensland Mus., 3: 161. (Type: Gordonvale, Queensland).

nigriclava Girault, 1915. Mem. Queensland Mus., 3: 179. (Type: Burnett Heads, Queensland).

ponderosa Girault, 1915. Mem. Queensland Mus., 2: 115–116. (Type: Nelson, Queensland).

tennysoni Girault, 1920. Insec. Inscit. Menstr. 8: 98. (Type: Cairns, Queensland).

LITERATURE CITED

- ANNECKE, D. P. AND R. L. DOUTT. 1961. The Genera of the Mymaridae. Hymenoptera: Chalcidoidea. S. Afr. Dep. Agr. Tech. Serv., Entomol. Mem., 5: 1–71.
- GIRAULT, A. A. 1913. Australian Hymenoptera Chalcidoidea—II. Supplement. Mem. Queensland Mus., 2: 107–129.
1914. Descriptions of new chalcid-flies. Proc. Entomol. Soc. Wash., 16(2): 109–119.
1923. Loves Wooded and Won in Australia. Privately publ., Brisbane. 3 pp.
- OGLOBLIN, A. A. 1935. Dos especies nuevas del genero *Paranaphoidea* Gir. (Hym. Mymaridae). Rev. Entomol. (Rio de Janeiro) 5(2): 149–153.

Synonymy of *Andricus gigas* and the Bisexual Generation of
Andricus crenatus

(Hymenoptera: Cynipidae)

D. CHARLES DAILEY AND CHRISTINE M. SPRENGER

Sierra College, Rocklin, California 95677

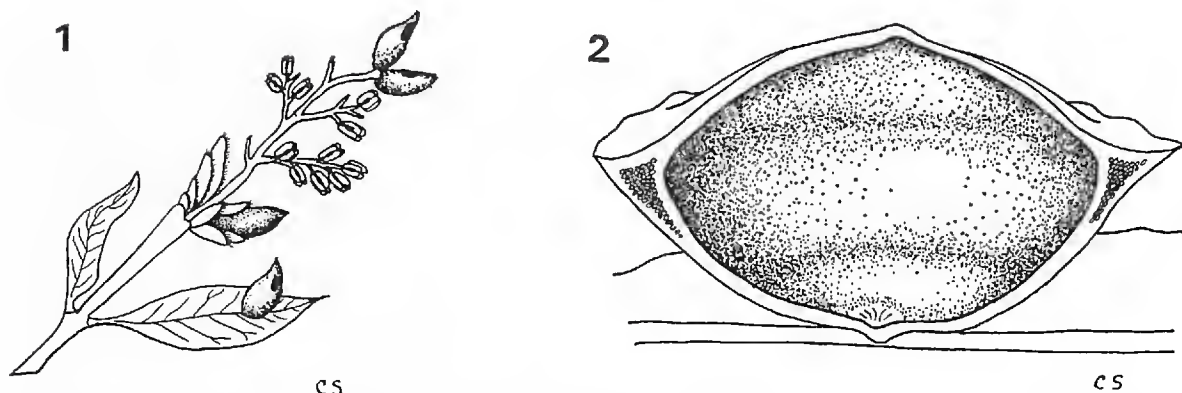
Field observations and rearings have shown the bisexual generation of *Andricus crenatus* Weld (1952) is *Andricus gigas* Kinsey (1922). Because Kinsey erroneously described a toothed tarsal condition, Weld (1951) transferred *A. gigas* to *Dryocosmus* Giraud. Due to the actual toothed tarsal claws of both generations, the species is now returned to the original placement in *Andricus* Hartig. The valid name again becomes *Andricus gigas*.

BIOLOGY.—The senior author made collections (November 1969) of *A. crenatus* from a *Quercus douglasii* Hooker & Arnott in Rumsey Canyon, Colusa County, California. The galls numbered 10 to 20 per leaf and comprised about 90% of the galls on the tree (Fig. 2). The unisexual generation females emerged in February and were bagged on a *Q. douglasii* in Davis, California for controlled rearing.

The tan, conical, bisexual generation galls produced occurred on the staminate flowers and occasionally in leaves (Fig. 1). Those at the base of staminate flowers were often hidden by bud scales. They were collected 14 April 1969 and yielded insects through 17 April 1969 while being maintained indoors. Galls were also collected from the original tree by the senior author on 16 April 1969. The ecology and description of the galls suggested that the bisexual generation of *A. crenatus* was *A. gigas*.

SYSTEMATICS.—The insects from the April 1969 rearings matched the original description of *A. gigas* with the exception of having a toothed rather than simple tarsal claw. Two circumstances suggested *A. gigas* Kinsey might in reality have a toothed tarsal claw and thus not belong in *Dryocosmus*.

First, the occurrence of a bisexual *Dryocosmus* on a California white oak is unusual for the following reasons. Nearly all American *Dryocosmus* occur on oaks of the subgenus *Erythrobalanus* (red oaks), but *A. gigas* was recorded from a *Lepidobalanus* (white) oak. No other described species of *Dryocosmus* from California occur on the white oaks. Since the name *A. gigas* represents a bisexual generation, which are generally smaller, less conspicuous, and more poorly known than the unisexual generation, the unknown alternate unisexual generation



FIGS. 1, 2. *Andricus gigas*. FIG. 1. Bisexual generation gall, 6 \times . FIG. 2. Unisexual generation gall, 40 \times .

of the species has either not been found or probably belongs to another genus.

Second, all of Kinsey's adults were imperfect, lacking full antennae. As of 1971 none of the type specimens in the American Museum of Natural History had a tarsal claw (J. G. Rozen, personal communication). Five other species described by Kinsey in the same 1922 paper, which were erroneously described as having simple tarsal claws, were correctly transferred by Weld (1951) to genera having toothed tarsal claws. The species transferred were *Andricus atrimentus* Kinsey, *Andricus pedicellatus* Kinsey, *Bassetia ligni* Kinsey, *Neuroterus varians* Kinsey, and *Neuroterus decipiens* Kinsey.

Though Weld's manuscript *Dryocosmus* key lists *Quercus lobata* Nee as an additional host and gives a larger maximum adult *A. gigas* size of 2.8 mm, his field notes (#1157a) and book (1957) give no definite indication that a species matching the original *A. gigas* description, including simple tarsal claw, has been collected subsequently.

This suggested the need to confirm the tarsal condition of *A. gigas*. Paratype (labeled Cotype) galls without emergence holes were dissected and one teneral adult female was extracted. The fore and mid right legs were removed and mounted on a slide. The tarsal claws are toothed. Thus *A. gigas* does not belong in *Dryocosmus*.

The assumption, from the previous paragraph, that the cotype gall, which matches the original description, is an *A. gigas* gall needs re-viewing. The dissected female is yellow-brown on the thorax, probably due to teneral coloration, and has distinct, complete notaulices while the original description indicates that the notaulices should be "fine but evident only posteriorly, less evident, discontinuous or absent anteriorly where the area is finely coriaceous." The paratype insects examined have discontinuous notaulices which do reach the pronotum,

but are weak. Tulloch (1929) stated, "An examination of the immature pupal stages of *Polistes* reveals the presence of these prescutal sutures which gradually disappear as the chitin hardens before attaining the adult condition." This may explain the more marked notaulices on the teneral adult.

These conditions all indicate the alternate generation of *A. gigas* is a senior synonym of the bisexual generation of *A. crenatus*.

There has been a great deal of confusion about the correct terminology to designate the thoracic furrows and lines of Hymenoptera. Tulloch (1929) reviewed the confusion in terminology used for thoracic lines in Hymenoptera and indicates the lateral-most lines on the Hymenoptera mesonotum medial to the suture are correctly referred to as parapsidal lines or furrows. Some Hymenoptera, including cynipids, also have longitudinal furrows correctly called notaulices, medially of the parapsidal furrows. The latter usually have been referred to incorrectly as parapsidal furrows by cynipid taxonomists. Eady and Quinlan (1963) use both terms correctly.

The wing venation terminology employed by Kinsey (1929) and Weld (1957) varies markedly from that used by Snodgrass (1935). Snodgrass, using the Comstock-Needham system, places the cubitus vein posterior to the median. Kinsey and Weld, however, refer to the median vein as being posterior to the cubitus. This terminology was possibly a carry-over from some older system. It is important to standardize the terminology for wing venation of cynipids with the Comstock-Needham system to avoid further confusion. Eady and Quinlan (1963) have corrected cynipid terminology to conform with the Comstock-Needham system and others working with cynipids should follow this corrected system.

TYPE DEPOSITION.—One plesiotype female, dissected from paratype gall, in the American Museum of Natural History, New York, New York.

ACKNOWLEDGMENTS.—The authors are grateful to Mr. Robert Lyon of Los Angeles City College for access to the Weld collection and field notes and for reviewing this paper, to Dr. Paul H. Arnaud of the California Academy of Sciences for the loan of paratype galls and insects, and to Dr. Jerome G. Rozen, Jr. of the American Museum of Natural History for the loan of paratype galls which yielded a teneral adult, making this paper possible.

LITERATURE CITED

- EADY, R. D. AND J. QUINLAN. 1963. Handbooks for the Identification of British Insects, Hymenoptera: Cynipidae, Key to Families and Subfamilies

- and Cynipinae (Including galls). Royal Ent. Soc. London, 7 pt. 1A: 81 p.
- KINSEY, A. C. 1922. New Pacific Coast Cynipidae. Amer. Mus. Nat. Hist. Bull., 46: 279-295.
1929. The Gall Wasp Genus *Cynips*. Indiana Univ. Stud., 16(2, 3, 4): 577 p.
- SNODGRASS, R. E. 1935. Principles of Insect Morphology. McGraw-Hill, New York, 667 p.
- TULLOCH, G. S. 1929. Proper Use of Terms "Parapsides" and "Parapsidal furrows" *Psyche*, 36: 376-382.
- WELD, L. H. 1951. p. 600-654 in Muesebeck, C. F. W., K. V. Krombein, and H. K. Townes. Hymenoptera of America North of Mexico. U. S. Dep. Agr., Monogr. 2, 1240 p.
1952. New American Cynipid Wasps from Galls. Proc. U. S. Nat. Mus., 102: 315-342.
1957. Cynipid Galls of the Pacific Slope. Privately Printed; Ann Arbor, Mich., 64 p.

RECENT LITERATURE

BEHAVIOR OF MARINE ANIMALS. CURRENT PERSPECTIVES IN RESEARCH. VOL. I: INVERTEBRATES. VOL. II: VERTEBRATES. Edited by Howard E. Winn and Bori L. Olla. Plenum Press, New York. 503 p. (1-244 + xxix; 245-503 + xviii). 1972. \$32.00 (\$16.00 each).

The articles on behavior of several groups of arthropods in Vol. I will be of special interest to insect behaviorists.—ROBBIN W. THORP, *University of California, Davis, 95616*.

INSECTS. Ross E. Hutchins. Prentice-Hall, Inc., Englewood Cliffs, N. J. 324 p. illus. 1966. Prism Paperback edition, 1972. \$3.50.

Pagination and text in the paperback edition are the same as in the original edition, but the smaller format reduces the size of type and photos. Many illustrations appear different, but are merely reduced, inverted or put on an angle to better fit the smaller page. A few illustrations (e.g. on pages 82, 114, etc.) are different, but without loss of quality.—ROBBIN W. THORP, *University of California, Davis, 95616*.

LOVE AND HATE. THE NATURAL HISTORY OF BEHAVIOR PATTERNS. Irenaus Eibl-Eibesfeldt. Translated by Geoffrey Strachan. Holt, Rinehart and Winston, Inc., New York. 276 p., 63 figs. 1972. \$7.95.

An ethologist examines the roots of some behavior patterns in man in light of some social interactions among higher vertebrates and a few social insects.—ROBBIN W. THORP, *University of California, Davis, 95616*.

The Genus *Paratrichogramma* Girault

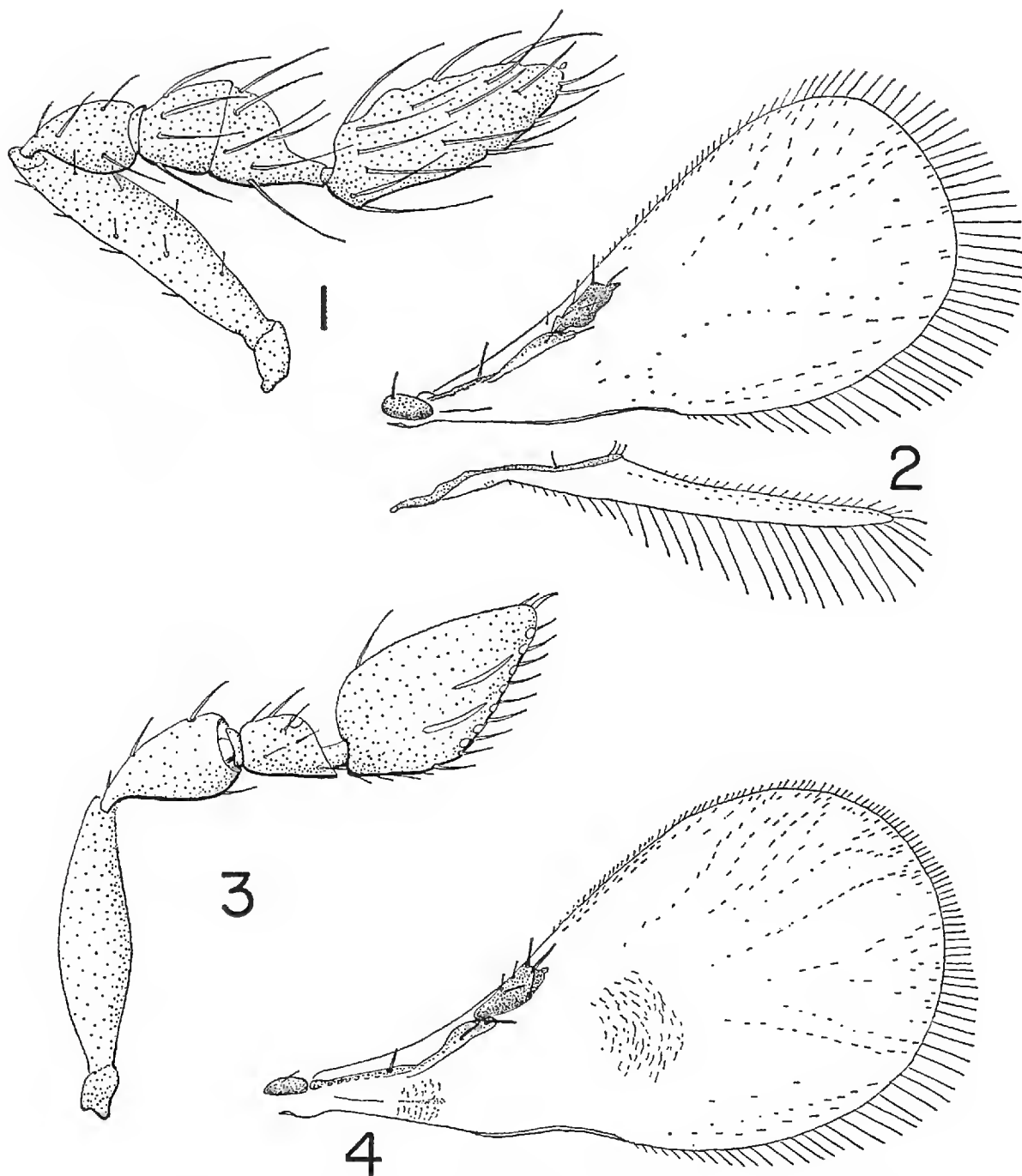
(Hymenoptera: Trichogrammatidae)

RICHARD L. DOUTT¹*University of California, Berkeley*

The genus *Paratrichogramma* is easily separated from the 71 other valid genera in the family Trichogrammatidae as recognized by Doutt and Viggiani (1968). Its female antennal formula of a single annellus, a single flagellomere, and a solid club is unusual and when this character is combined with the distinctive wing venation the genus is readily set apart. Similarly the males are almost unmistakable, and would not be easily confused with other members of the family because of the peculiar bottle-shaped second funicle segment.

There are two species described from Australia, namely *P. cinderella* Girault, which was illustrated by Doutt and Viggiani (1968), and *P. fusca* Girault. The type of *P. fusca* is apparently lost, for Girault deposited it in the Queensland Museum with the number "Hy/803" and indicated (Girault, 1912) that it was mounted "in xylol-balsam with the type female of *Polynema spenceri* Girault and two trichogrammatids." I have examined a slide in the Queensland Museum which does have the type of *P. spenceri*, a male of *Trichogramma australicum*, and a chalcid body with several fragmented legs but no tarsi, no head, no antennae, and no wings. The slide is labelled "*Paratrichogramma fusca* Girault ♀ Hy/803", and the locality data match the original description. In red ink the label also has the number 3415, which corresponds to the number given *P. fusca* by Girault in an unpublished revision of his collection. However, in red ink on the slide label under the designation "*Paratrichogramma fusca*" Mr. Girault has also written "destroyed." All of this evidence indicates that the type specimen of *P. fusca* was originally on this particular slide, but now it must be considered as missing or destroyed. This is especially unfortunate because Girault's original description is too brief and inadequate to form a satisfactory concept of the missing specimen. Perhaps the most useful and reliable distinction is that Girault considered *P. fusca* to have forewings more densely ciliated discally than *P. cinderella* with about 18 long lines of cilia instead of 5 short lines from the apex as in *P. cinderella*.

¹ Present address: 9240 S. Riverbend Avenue, Parlier, Ca. 93648.

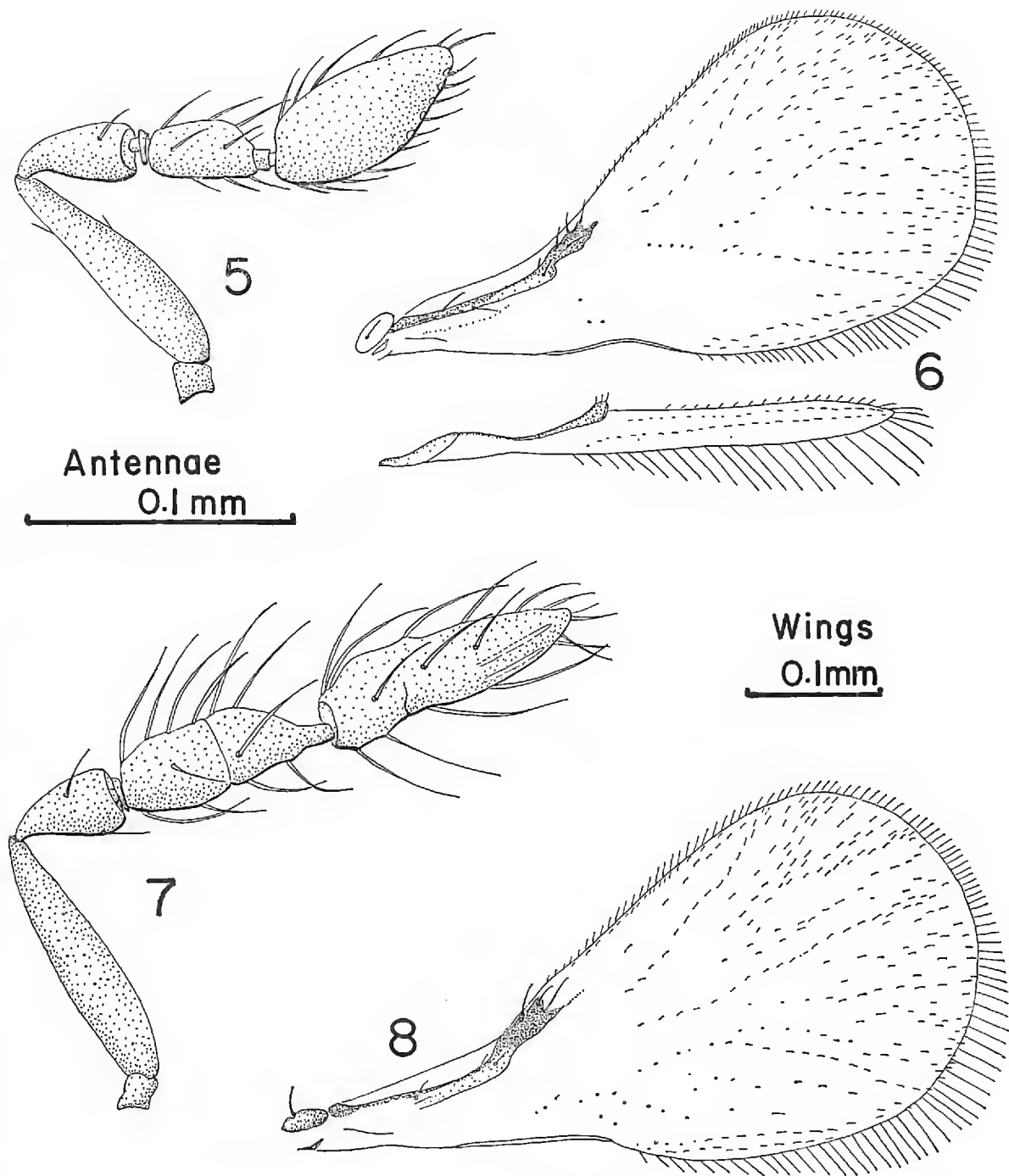


FIGS. 1-4. *Paratrichogramma pretoriensis*. FIG. 1. Male antenna. FIG. 2. Male wings. FIG. 3. Female antenna. FIG. 4. Female forewing.

There are 4 specimens of *P. cinderella* at the Queensland Museum and one at the U.S.N.M. The distribution from these individuals is indicated as Queensland and Thursday Island (Torres Strait). This constituted the extent of our information on the genus until a few *Paratrichogramma* were recognized in collections from California and South Africa. These represent new species and are described as follows:

***Paratrichogramma pretoriensis* Doult, new species**

FEMALE.—Length 0.45 mm; body color golden brown, head yellow gold, eyes and ocelli bright red, antennae light brown, coxae dark, trochanters white, femora



FIGS. 5-8. *Paratrichogramma californica*. FIG. 5. Female antenna. FIG. 6. Female wings. FIG. 7. Male antenna. FIG. 8. Male forewing.

and tibiae white with median area dark, banded, apex of tibiae and third tarsomere dark, wings hyaline, venation brown. Head, frontal view slightly wider than long, face deeply impressed, roughly sculptured; eyes large; toruli low on face, ocelli large, prominent; mandibles with two pointed teeth, third blunt; eyes without spicules; antennae as Fig. 3 with long scape, large pedicel, single annellus, single flagellomere with stalk-like peduncle attachment to single club. Scutum and scutellum with light, reticulated sculpture; thorax broad as abdomen, slightly over half length of abdomen, phragma large, wide, parallel sided, broadly truncate at apex, extending to middle of abdomen. Ovipositor small, not exerted. Fore femora longer than tibiae; foretarsi with short basitarsus; middle and hind tibiae

longer than femora, basal tarsomeres as long or longer than succeeding segments. Wings as Fig. 4 with broad marginal vein and sessile stigma; center of wing disc with rough leathery texture.

MALE.—Body color similar to female, slightly darker. Wings dusky at base; head, legs, antennae colored as female. Face impressed, eyes smaller than female; antennae as in Fig. 1 with peculiar bottle-shaped second funicle. Thorax as wide as abdomen, half length. Scutum with reticulate sculpture only on anterior portion, scutellum smooth. External genitalia large. Wings as in Fig. 2.

Paratrichogramma pretoriensis is readily differentiated from *P. cinderella* by the broader marginal vein and more abundant discal cilia of the forewings; and from *P. californica* by the reticulated sculpturing of the scutum.

Holotype female and allotype from suction trap 1 (1029), PRETORIA, SOUTH AFRICA, February 1958. D. P. Annecke. Paratype male from suction trap, Pretoria, South Africa, March 1958. D. P. Annecke. Holotype and allotype to be deposited at Plant Protection Research Institute, Pretoria. Paratype at Division of Biological Control, University of California.

***Paratrichogramma californica* Doult, new species**

FEMALE.—Length 0.45 mm, body dark brown, except propodeum golden, head bright golden yellow, eyes and ocelli crimson, antennae pale gold, legs light brown to smoky becoming pallid at tips of tibiae and basal tarsomeres, but hind coxae dark brown, wings hyaline, smoky near base, veins brown. Eyes with inner margins straight, eyes extend three-fifths length of face; toruli low on face; face deeply impressed, sculptured by transverse ridges; mandibles with two distinct teeth and truncate shoulder; antennae with long scape, pedicel slightly shorter than single funicle segment, club obliquely truncate (Fig. 5). Body compact, stout; scutum without distinct reticulated sculpture as occurs in *P. pretoriensis* and *P. cinderella*. Thorax slightly shorter than abdomen, phragma large, extending nearly to middle of abdomen. Ovipositor about half length of abdomen, small hypogynium at base, not exerted. Legs somewhat slender, rather long for compact body, hind coxae especially elongate, fore femora and fore tibiae about equal length. Wings as in Fig. 6.

MALE.—Body color pattern basically as female but darker, with very dark band across abdomen. Head with transverse sculpturing similar to female, eyes smaller, extending just half length of face. Antennae (Fig. 7) with peculiar bottle-shaped second funicle, club has suggestion of fused basal segment. Scutum with reticulations on anterior-lateral areas. Phragma extending posteriorly three-fifths length of abdomen. Wings as in Fig. 8.

Holotype female, allotype, one paratype female HUB, CALIFORNIA, 27 August 1956, from *Atriplex bracteosa*. C. E. Kennett. One paratype female, from *Atriplex bracteosa*, 4 mi. W Kearney Park, Fresno Co., Calif. 13 September 1951. C. E. Kennett and C. B. Huffaker. Type series at Division of Biological Control, University of California.

LITERATURE CITED

- DOUTT, R. L. AND G. VIGGIANI. 1968. The classification of the Trichogrammatidae (Hymenoptera: Chalcidoidea). Proc. Calif. Acad. Sci., 35(20): 477-586.
- GIRAULT, A. A. 1912. Australian Hymenoptera Chalcidoidea—I. Mem. Queensland Mus., I: 66-189.

SCIENTIFIC NOTE

***Leptocoris rubrolineatus*, an Occasional Predator of the California Oakworm, *Phryganidia californica* (Hemiptera: Rhopalidae; Lepidoptera: Diopitidae).**—In coastal California, the western boxelder bug, *Leptocoris rubrolineatus* Barber, occurs in large numbers on bigleaf maple, *Acer macrophyllum* Pursh. The adult bugs are often common on nearby vegetation, including coast live oak, *Quercus agrifolia* Nee, on which feed larvae of the California oakworm, *Phryganidia californica* Packard.

Boxelder bugs have heretofore been recorded feeding only on plant hosts (Metcalf, Flint, and Metcalf, 1962, *Destructive and Useful Insects*, 4th ed. McGraw-Hill, N. Y.). While investigating mortality of the California oakworm, I noticed *Leptocoris* adults feeding on oakworm pupae. The oakworm forms a hanging chrysalid with no surrounding cocoon. A careful search of a coast live oak trunk near the campus of California State University, Hayward, on 2 July 1970 revealed 109 oakworm pupae, of which 8 were being fed upon by adult *Leptocoris*. The tree was 12 m from the trunk of a bigleaf maple swarming with boxelder bugs. A search of oaks 45 m and 51 m from this maple revealed few *Leptocoris*, none of which were feeding on oakworm pupae.

I collected 10 adult *Leptocoris* and placed them in a plastic petri dish with 50 oakworm pupae. They fed readily on the pupae though no alternate food was available. Pupae upon which the bugs fed did not survive. In the field, for up to 45 minutes each, I followed individual boxelder bugs that had completed feeding on oakworm pupae, and in no case did they feed on additional pupae. To estimate the extent of predation by *Leptocoris*, I examined oakworm pupae from several oaks growing within 20 m of maples, but I was unable to accurately distinguish feeding sites of *Leptocoris* from oviposition punctures of parasitic Hymenoptera, which were also common in the area.

Harville (1955, Microent. 20: 83-166) makes no reference to *Leptocoris* predation in his discussion of natural mortality of *Phryganidia*. Feeding on oakworm pupae by *Leptocoris* is probably of little significance in oakworm population dynamics because of its localized nature though it is interesting to note a normally phytophagous insect feeding on animal matter.—DAVID J. HORN, *Department of Entomology, The Ohio State University, Columbus, 43210.*

**Behavioral Studies of Three Morphotypes of
*Therion circumflexum***

(Hymenoptera: Ichneumonidae)

C. N. SLOBODCHIKOFF

Department of Biological Sciences, Northern Arizona University, Flagstaff, 86001

Therion is a genus of wasps that are parasitoids of Lepidoptera caterpillars. The female lays an egg into the body cavity of a host caterpillar; the egg develops into a larva that feeds on the host's non-vital tissues. Eventually the host pupates, at which time the parasitoid larva kills the host, pupates inside the host's pupal shell, and emerges from the pupal shell as an adult wasp. It has recently been shown that all North American *Therion* can be considered as members of a single species, *T. circumflexum* (L.), with distinct groups of populations that can be segregated into ten separate morphological types or morphotypes (Slobodchikoff, 1971). The purpose of the present paper is to report on the behavior of three of the ten morphotypes.

The behavior of the three morphotypes, CIRCUMFLEXUM, CALIFORNICUM, and MORIO was studied both in the field and in the laboratory. When this study was begun, it was expected that minor differences would be observed between morphotypes in most of the behavioral categories described in the present paper. However, observation and experimentation demonstrated that all three morphotypes have the same behavioral response patterns in every category except host selection.

MATERIALS AND METHODS

The materials and methods used in the behavioral studies were the following. CALIFORNICUM adults were observed while contained in a sleeve cage, 0.5 m on each side with a fine wire mesh. CIRCUMFLEXUM and MORIO adults were observed while contained in transparent plastic shoeboxes and in half-gallon ice cream cartons covered with a piece of 2 mm-thick glass. The shoeboxes had their ends cut off and substituted by a fine wire mesh. The top of each shoebox had a 5 × 6 cm mesh to insure proper ventilation and had three circular holes, each measuring 2.5 cm in diameter, for introducing food, water, and experimental items. These circular holes were normally plugged with cotton. Wasp parts were weighed on a Mettler balance to the nearest 0.05 mg. Potter's clay was used for constructing the model of

the insect in flight. The model was baked in a Braun oven at 40° C for 24 hours, then allowed to cool for 24 hours. The response to light was tested with an American Optical Company microscope illuminator and a gooseneck desk lamp with a 100 watt bulb. Temperature was measured by a Celsius thermometer and by a hygrothermograph. Temperature in the laboratory remained at $20 \pm 2^\circ$ C, relative humidity averaged 40 per cent. Mating was observed in part while the wasps were caged in a 90×30 mm glass vial with a cotton plug at the top.

RESULTS AND DISCUSSION

HABITATS STUDIED.—Extensive field observations of CIRCUMFLEXUM'S behavior were made at Lily Lake, Marin County, California. Lily Lake is situated in the California Coast Ranges, and is surrounded by hills and ridges with narrow canyons containing seasonal streams. The habitat around Lily Lake may be characterized as grassland along the tops of ridges, oak-chaparral woodland among the slopes of the hills, and mixed evergreen-redwood forest along the canyon floors. CIRCUMFLEXUM was found only in the oak-chaparral areas. Individuals of this morphotype were typically seen flying around oaks and in the grass surrounding oak trees. Specimens of CALIFORNICUM were collected from similar habitats in areas near Lily Lake. Observations of the behavior of CALIFORNICUM were made at Hallelujah Junction, Lassen County, California, and at a cotton field near Kerman, Kern County, California. Hallelujah Junction has a Great Basin flora and fauna. *Therion* individuals were found flying around willows along a stream. The cotton field near Kerman was, at the time the observations were made, an experimental plot for control of bollworm (*Heliothis zea* (Boddie)) by *Bacillus thuringiensis* Berliner, and had not been sprayed with insecticides for the previous two years.

The behavior of MORIO was observed at Verdi, Washoe County, Nevada, in a patch of willows along the Truckee River. The habitat around Verdi may also, like Hallelujah Junction, be characterized as Great Basin. Only three females and four males were found at this locality during two days of observation. No other *Therion* were found in surrounding willow patches for half a mile in either direction along the Truckee River. The Verdi colony is probably an isolated one with a low population density.

In California, the three morphotypes are often found in the vicinity of willows. CALIFORNICUM is also found in cotton and alfalfa fields. In addition to willows, CIRCUMFLEXUM is found near oaks

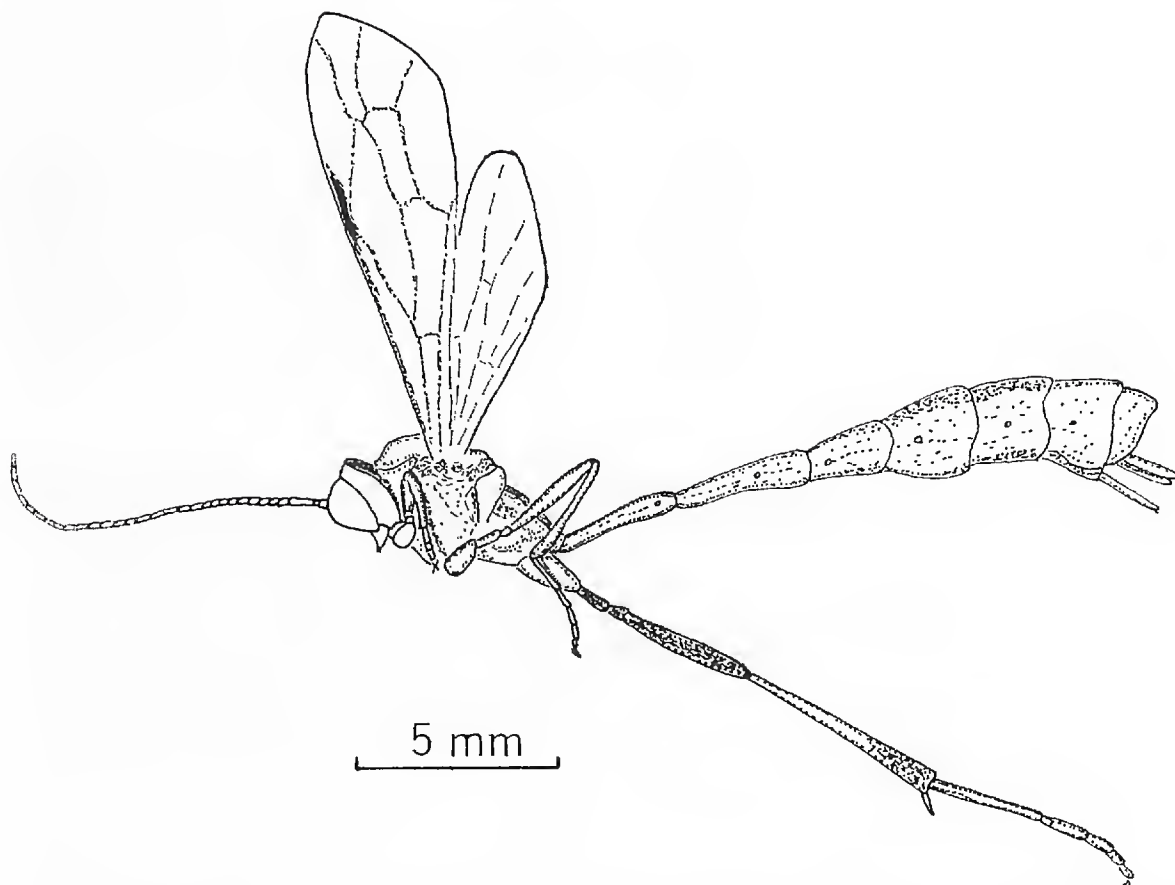


FIG. 1. Female *T. circumflexum* in flight. Adapted from a 35 mm photograph.

in oak-woodland habitats. MORIO has only been recorded from habitats containing willows. In all observed cases, the *Therion* lived in isolated colonies. At a given locality, all the *Therion* individuals were found within a small area, often less than one square mile in size. Outside of this area, no *Therion* were found, although the habitat was quite similar in surrounding areas.

FLIGHT.—*Therion* males and females characteristically fly with the abdomen elevated and the hind legs outstretched (Fig. 1). Sometimes the middle and front pairs of legs are extended to the sides, with the femora pointed laterally away from the thorax and the tibiae and tarsi pointed downward. As the wasp flies, the abdomen may be seen to occasionally move up or down. This movement follows a change in the position of the thorax relative to a horizontal plane. If the thorax dips forward, so that the head is lowered and the propodeum is raised, the abdomen moves down. If the thorax dips backwards, so that the head is raised and the propodeum is lowered, the abdomen moves up. If an imaginary plane is extended through the thorax while the wasp is in flight, so that half of the thorax is above this plane and half is below, the abdomen is held at a 20 degree angle above the plane and the legs are held at a 20 degree angle below the plane.

Table 1. Measurements of body parts of a male *circumflexum*.

Part	Weight mg	Dimensions mm (l × h × w)	Volume mm ³
Head	2.75	1.3 × 1.7 × 2.0	4.42
Thorax and wings	12.40	6.0 × 3.0 × 3.0	54.00
Abdomen	9.00	16.0 × 2.2 × 0.8	26.40
Hind legs	2.55	17.5 × 0.5 × 0.5	4.38

The wasp in flight may be considered as three separate arms balanced around a center of gravity. The thorax, head, wings, and first two pairs of legs comprise one arm. The hind pair of legs comprise the second arm, and the abdomen comprises the third arm. On the basis of observations of the movement of these arms, the center of gravity of the wasp in flight may be predicted to be at the point where the arms join, near the hind end of the propodeum. If the head pitches forward or backward, the center of gravity shifts. To compensate for the shift, the abdomen moves either up or down, bringing the center of gravity back to the end of the propodeum.

To see whether the center of gravity of a wasp is actually at the end of the propodeum, an experiment using a clay model was performed. A male CIRCUMFLEXUM, freshly killed, was cut into the following parts: (1) the head; (2) the thorax, wings, and first two pairs of legs; (3) the abdomen, including the petiole; and (4) the hind legs, including the coxae. These four parts were weighed and were measured. The volume of each part was calculated. The data obtained from these measurements are summarized in Table 1. A scale model was made, attempting to reproduce the actual contours of the wasp as closely as possible. The scaling factor for the weight was 1×10^3 , and the factor for the dimensions was 0.5×10 . The abdomen and legs were fixed at 20 degree angles with respect to the horizontal plane. When the model was suspended by a string tied around the juncture of the abdomen, legs, and thorax, the model balanced in the position that the wasp uses for level flight.

RESTING AND GROOMING.—In both the laboratory and in the field, *Therion* adults may frequently be observed at rest clinging to an object in a head-upright position perpendicular to the ground, and either remaining motionless or cleaning portions of the body. Cleaning consists of a series of actions. First one antennal flagellum, then the other, is drawn through the space between the strongly curved front tibial spur

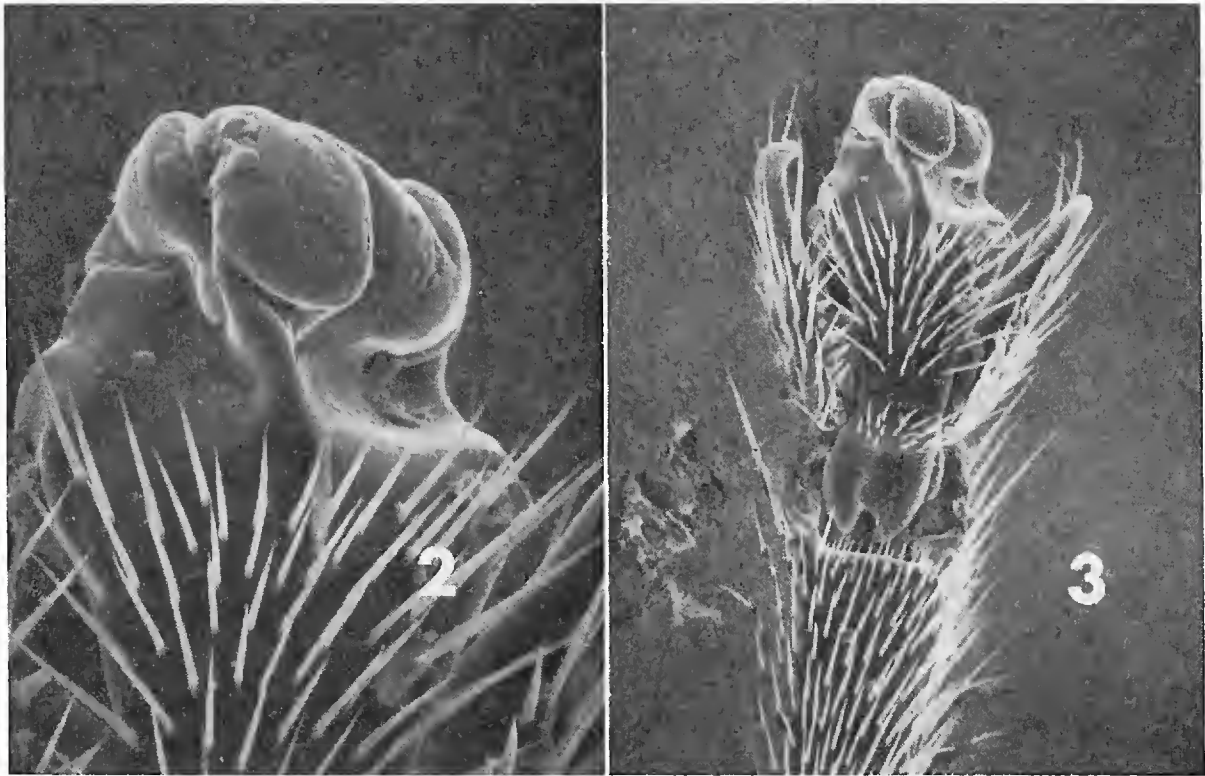


FIG. 2. Spongy empodium between tarsal claws of *T. circumflexum*. Scanning electron micrograph, 420 \times . FIG. 3. Tarsal pad and spongy empodium, tarsal segments 4-5 of *T. circumflexum*. Scanning electron micrograph, 170 \times .

and the first tarsal segment. The right front leg cleans the right flagellum, while the left front leg cleans the left one. The tibial spur and the front tarsal segments are then brushed against the mouthparts, each leg brushing the mouthparts on its own side. Following this, the tarsal segments and tibial spur of the middle leg are brushed against the end of the tibia and the tarsal segments of the front leg. The same action is repeated by the hind legs, brushing against the tibia and tarsal segments of the middle leg. Then the wings are held out flat on either side of the abdomen, with their upper surfaces parallel to the dorsum of the wasp. The tibia of one hind leg brushes against the surface of the other two wings. After cleaning the wings, the hind legs are used to brush the posterior half of the abdomen. This is accomplished by simultaneously moving the tarsal segments and tibial spurs of each hind leg along the sides of the abdomen toward the posterior end. The abdomen-brushing action is usually repeated 2-3 times. Cleaning behavior concludes with the brushing of the tibial spur and lower surfaces of the tarsal segments on one hind leg against the upper surface of the other leg's tarsal segments, then a corresponding action for brushing the segments of the other leg.

Therion adults often cling to blades of grass or small twigs during resting in the field. In the laboratory they are capable of clinging to

glass and smooth plastic as well as to materials such as twigs, paper towels, and wire meshes. Clinging to smooth surfaces is facilitated by a large, spongy, empodium (Fig. 2) on the pretarsus and by four tarsal pads per leg. Each tarsal pad lies in the intersegmental space between tarsal segments, and appears to overlap the segment distal to it (Fig. 3). The pad consists of spongy ridged tissue that, when pressed against a smooth surface, has a suction effect. The empodium also functions as a suction pad.

RESPONSE TO LIGHT.—Both males and females of the three morphotypes exhibit positive phototaxis. If given an intensity gradient of light, the wasps will move to the area of greatest intensity. A simple experiment was performed to establish this. Eight males and ten females of *CIRCUMFLEXUM* were confined in a plastic cage. The cage was placed in a darkened room at 9 p.m., PDT, for one hour. A microscope illuminator, set at low intensity (300 ft. candles at the end of the cage nearest light, 100 ft. candles at the middle of the cage), was placed one foot from one end of the cage. The illuminator was positioned so that the beam of light would pass along the length of the cage. At the end of one hour, the illuminator was switched off. Initially, the *Therion* were distributed fairly uniformly in the cage, all in resting positions. However, within five seconds of application of the light stimulus, movement was elicited. Within 30 seconds, seven males and all ten females had crawled or flown to the side of the cage closest to the light. Within one minute, all the individuals were along that side. This experiment was repeated three times on separate days. In each case, all individuals were along the side closest to the light within one minute. The wasps showed no habituation to the light, and remained at the side of the cage nearest to the light until the light was switched off.

The same experiment was performed with four males and three females of *MORIO*, under similar experimental conditions. In three replicates, on separate days, the same results as with *CIRCUMFLEXUM* were obtained. *CALIFORNICUM* males and females were found to respond in a similar fashion to a desk lamp after a period of darkness. If a diffuse light, such as that produced by an overhead white fluorescent lamp, was switched on after a period of darkness, and the intensity gradient was comparatively low, the wasps of all three morphotypes became active within one minute. However, they did not congregate at any given side of the cage.

RESPONSE TO TEMPERATURE.—Both *CALIFORNICUM* and *CIRCUMFLEXUM* become increasingly active with temperatures higher than

ca. 15 degrees C. CALIFORNICUM adults at Hallelujah Junction and near Kerman begin to appear about 7:30 or 8:00 a.m., PDT, when the temperature begins to exceed 17 degrees C. CALIFORNICUM adults near Lily Lake, where temperatures are generally cooler, become active later in the day, around 9:30 or 10:00 a.m., PDT, when the temperature begins to exceed 15 degrees C. On sunny warmer mornings, CIRCUMFLEXUM adults at Lily Lake become active earlier than on cooler sunny mornings. The same response to temperature has been reported for eastern MORIO by Tothill (1922).

MATING.—The mating behavior of CALIFORNICUM and CIRCUMFLEXUM was observed in the laboratory, but not in the field. The mating behavior of MORIO was not observed. CALIFORNICUM was observed mating on two occasions, one while the individuals were confined in the plastic cage described above, and one while the individuals mating were confined in a glass vial.

Both morphotypes go through the same set of actions for mating. Tothill (1922) reports that MORIO mates by pairing in flight and falling to the ground. No pairing in flight was observed for the two morphotypes studied, but that may be a consequence of laboratory confinement. In both morphotypes, the male approaches the female from the rear and moves his antennae along the posterior half of her abdomen 2–5 times. He then climbs onto her dorsum, curls his abdomen around so that the tip of the genital capsule is pointing anteriorly, and couples with her.

The male and female remain coupled for 1–2 minutes (55 and 104 seconds for CALIFORNICUM, 70 and 78 seconds for CIRCUMFLEXUM), following which the female immediately flies off. The male, however, remains motionless for about another minute (45 and 62 for CALIFORNICUM, 48 and 75 seconds for CIRCUMFLEXUM). In all four observed matings, the male assumed the characteristic position taken by wasps at death. The wings were partially spread to the sides and depressed, the abdomen was partially curled underneath itself, and the legs were spread to the sides. The CIRCUMFLEXUM individuals were field collected and it is not known if any sperm was transferred during the observed matings, but the CALIFORNICUM individuals were laboratory reared, and gave rise to female progeny. Tothill (1922) reports that in two observed matings of MORIO, the individuals remained coupled for five and fifteen minutes respectively.

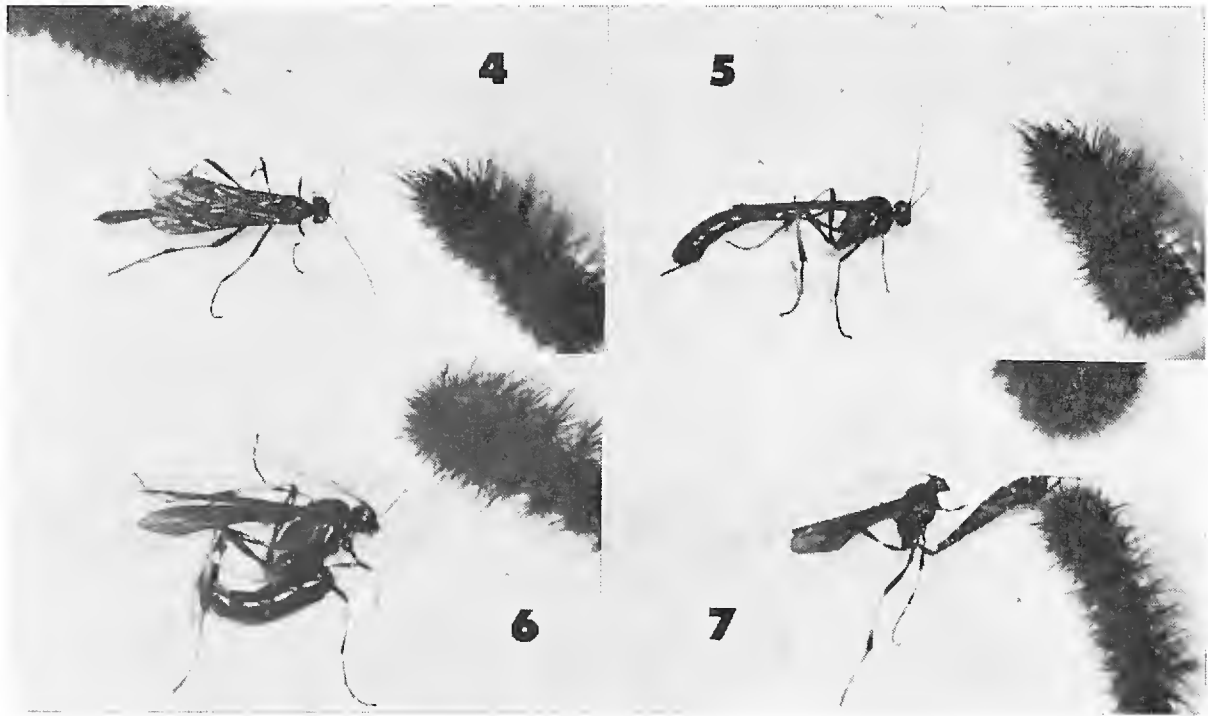
FEEDING AND DRINKING.—In the laboratory males and females readily accept either a diet of clover honey mixed with tap water in a 1:1 proportion or a diet of pure clover honey. These diets provide sufficient

nutrients for the wasps to produce viable progeny. With either diet, water is the only other requirement. Wetting a piece of cotton in the cage is a convenient way of providing the water, since the wasps can easily extract the absorbed liquid. Water has to be provided daily. When three laboratory-reared, newly emerged individuals of CALIFORNICUM were fed diluted honey but were deprived of pure water, all three wasps were found dead at the end of 36 hours. The general characteristics of drinking behavior in ichneumonids have been discussed by Townes (1958). Tothill (1922) found that adults of MORIO in the eastern United States eat pollen grains of goldenrod in the field, and will eat sugar mixed with water, the fresh inside of a banana skin, or pollen grains of goldenrod in the laboratory. The adults of CALIFORNICUM and CIRCUMFLEXUM probably also normally feed on pollen grains.

HOST SEARCHING AND SELECTION.—When searching for hosts, females of all three morphotypes characteristically fly in slow zigzags not more than 1.5 meters above the ground. Periodically, a female will alight on a twig, leaf, or grass stem and explore the surrounding area within a 15 cm radius. During such explorations, the antennae are moved up, down, and from side to side, frequently touching the substrate on which the female is walking. Following a local exploration, the female resumes her zigzag pattern of flight.

The factors involved in host selection have been described elsewhere (Slobodchikoff, 1971). Odor provides an important initial cue that allows the wasps to find a potential host. Once the host is located, a female uses tactile cues provided by the surface of the caterpillar. The hosts of CIRCUMFLEXUM and CALIFORNICUM have no secondary setae on the integument, while the hosts of MORIO have dense patches of secondary setae. A female of all three morphotypes will approach a potential host and extend her antennae to the caterpillar's surface, briefly touching the caterpillar. If a MORIO female encounters an integument bare of patches of secondary setae, she loses all further interest in the caterpillar as a potential host. Similarly, females of CIRCUMFLEXUM and CALIFORNICUM lose all interest in a potential host, even in the presence of the proper odor, if an antennal scan of the surface encounters anything other than a wrinkled integument free of secondary setae. Even when a female wasp is deprived of suitable hosts for prolonged periods of time, caterpillars with improper cues are rejected as hosts.

OVIPOSITION.—Oviposition behavior begins when the wasp encounters a suitable host. In all three morphotypes studied, oviposition follows



FIGS. 4-7. Oviposition behavior sequence of female *T. circumflexum*, morphotype MORIO, in response to a woolly bear caterpillar, *Estigmene acrea* Drury. In this particular sequence, the female wasp misjudged the position of the caterpillar. See text for further explanation.

the same pattern. With her antennae held above her head, the female approaches to within 1.0–1.5 cm of the larva. She taps either the larval integument (if the larva is relatively hairless) or several larval hairs (if the larva is hairy) a few times with her antennae (Fig. 4). Then the antennae are raised above the head again. The abdomen is curled under the thorax so that the tip of the ovipositor is below and slightly in front of the head (Fig. 5). The abdomen fits between the hind coxae, which are pressed against the sides of the abdomen. The wasp typically cants her body to either her right or her left side, so that the dorsum of the wasp is held at approximately 45 degrees relative to the substrate on which the wasp is standing (Fig. 6). This allows her to rapidly extend the abdomen without interference from the substrate. If she decides to sting the host, the entire abdomen is rapidly thrown forward and the ovipositor pierces the larval integument. With the extension of the abdomen, the thorax is pulled up and back, and the first two pairs of legs are lifted from the surface of the substrate (Fig. 7). Actual egg-laying, from the time the abdomen is thrust forward, takes less than one second. The ovipositor penetrates to the body wall opposite the point of entry. This was first recorded by Tothill (1922) as characteristic of egg-laying by MORIO. After ovipositing, the female usually cleans herself.

CONCLUSIONS

The similarities and differences of behavioral patterns can be interpreted in terms of selection pressure and partitioning of the environment. All three morphotypes are sympatric, in the broad sense, through at least part of their range (Slobodchikoff, 1971). However, populations of the three morphotypes are usually small, with each population distributed over less than two square miles. Populations of the different morphotypes generally do not overlap, so that functionally the morphotypes are microallopatric. At the same time, populations of different morphotypes may be separated by as little as two miles, and may occur in the same type of habitat. Fluctuations in population size may bring two different morphotypes into contact, in which case it would be advantageous to insure maximum survival of progeny. Selection would be expected to have a disruptive effect on host preferences, and a neutral effect on all behavioral patterns not directly connected with the survival of offspring.

LITERATURE CITED

- SLOBODCHIKOFF, C. N. 1971. Patterns of differentiation and evolution in the genus *Therion* (Hymenoptera: Ichneumonidae). Univ. Calif., Ph.D. dissertation.
- TOTHILL, J. D. 1922. The natural control of the fall webworm (*Hyphantria cunea* Drury), in Canada together with an account of its several parasites. Can. Dep. Agr. Tech. Bull., No. 3, 107 p.
- TOWNES, H. K. 1958. Some biological characteristics of the Ichneumonidae (Hymenoptera) in relation to biological control. J. Econ. Entomol., 51: 650-652.

 RECENT LITERATURE

HEWISTON ON BUTTERFLIES 1867-1877. With a preface by Dr. L. G. Higgins. E. W. Classey, Ltd., Middlesex, England. 200 p. 1972. \$12.50. North American Distributor: Entomological Reprint Specialists.

A reprinted collection of four articles containing descriptions of exotic Lepidoptera, mostly Neotropical.—ROBBIN W. THORP, *University of California, Davis, 95616*.

THE ENVIRONMENT, THE ESTABLISHMENT AND THE LAW. Harmon Henkin, Martin Merta, and James Staples. 223 p., illus., 1971.

A review of the DDT controversy centering on the 1968-1969 hearings conducted in Madison, Wisconsin with many direct quotes from the testimony given. Appendices include the ruling, a model pesticide law and a glossary defining many words unfamiliar to the layman including "entomologist."—ROBBIN W. THORP, *University of California, Davis, 95616*.

The Ant Larvae of the Tribes Basicerotini and Dacetini: Second Supplement

(Hymenoptera: Formicidae: Myrmicinae)

GEORGE C. WHEELER AND JEANETTE WHEELER
*Laboratory of Desert Biology, Desert Research Institute,
University of Nevada System, Reno, 89507*

Subsequent to the publication of our first supplement on the larvae of the subfamily Myrmicinae (Wheeler and Wheeler 1960a)¹ we have received from other myrmecologists so much additional material that it has become necessary to publish another supplement.

Tribe BASICEROTINI

Brown and Kempf (1960: 165).—Differences between larvae of Basicerotini and Dacetini are based on our 1954 paper.

Genus BASICEROS Schulz

Brown and Kempf (1960: 171).—Larval characters after our 1954 description.

Genus RHOPALOTHRIX Mayr

We have changed our minds about *Rh. gravis* Mann (1954: 117): we now regard our material as mature and classify its profile as aspididri-form (Wheeler and Wheeler 1960b: 103, 106).

Genus EURHOPALOTHRIX Brown and Kempf

Profile myrmiciform. Head large. Body hairs numerous, short to long; of two types: (1) flexuous and denticulate and (2) flexuous, denticulate, ending in a sharp-pointed bulb, on the dorsum of AI to AVI (two per somite). Cranium subcordate. Antennae minute. Head hairs short to long, denticulate and moderately numerous. Mandibles leptothoraciform. Maxillae with a constriction between palp and galea.

In our 1960b key (p. 109) *Eurhopalothrix* would run to *Orectognathus*, from which it may be distinguished by its lack of bifid hairs.

EURHOPALOTHRIX AUSTRALIS Brown and Kempf

(Fig. 1)

Length (through spiracles) about 2 mm. Profile myrmiciform (i.e., stout and rather elongate; diameter greatest at AIV and AV; slightly attenuated anteriorly;

¹ We shall cite each of our papers the first time it is referred to with our names as authors; in subsequent citations we shall use date.

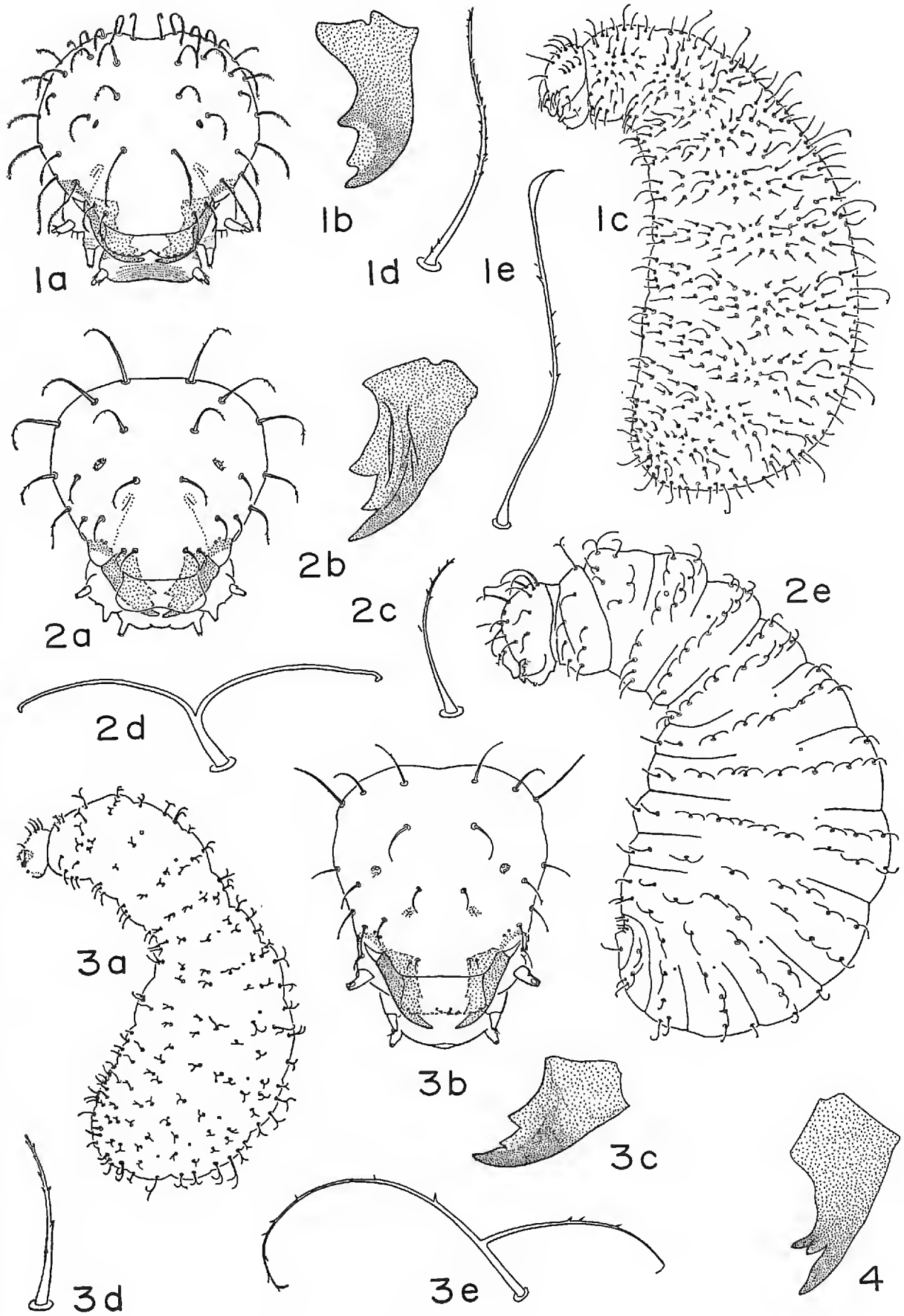


FIG. 1a-e.—*Eurhopalothrix australis*. a, Head in anterior view, $\times 111$; b, left mandible in anterior view, $\times 267$; c, larva in side view, $\times 35$; d, e, two types of body hairs, $\times 263$. FIG. 2a-e. *Colobostruma* sp. a, Head in anterior view, $\times 111$; b, left mandible in anterior view, $\times 267$; c, d, two types of body hairs, $\times 267$; e, larva in side view, $\times 42$. FIG. 3a-e.—*Mesostruma browni*. a, Larva in side view,

thorax stout and arched or bent ventrally, but not differentiated into neck; posterior end broadly rounded). Anus ventral. Head on anterior end and of about same diameter as T1. Spiracles small. Integument of ventral surface of thorax and AI and AII with few short transverse rows of minute spinules. Body hairs numerous and uniformly distributed, denticulate. Of two types: (1) 0.04–0.15 mm long, on all somites, shorter without and longer hairs with alveolus and articular membrane; (2) about 0.15 mm long, with stout shaft and slightly swollen bulb just below sharp-pointed tip, two on dorsal surface of each AI–AVI. Cranium somewhat broader than long and feebly cordate. Antennae minute, each with three sensilla, each bearing a minute spinule. Head hairs moderately numerous, short to long (0.038–0.075 mm), denticulate and slightly curved. Labrum bilobed, short and broad; each lobe with three or four minute hairs and/or sensilla on anterior surface, with minute spinules in short rows and with one isolated and two contiguous sensilla on ventral border, with coarse isolated spinules on the lateral border and with cluster of three sensilla on posterior surface; entire posterior surface spinulose, spinules minute and in numerous rows, rows transverse in middle half. Mandibles leptothoraciform (i.e., moderately narrow, tapering gradually and curving gradually to apical tooth; anterior surface produced medially into blade with two subapical teeth), with three or four denticles on posterior surface. Maxillae large, each divided by constriction between palp and galea, distal portion spinulose and with conoidal apex; palp digitiform, with five sensilla (two apical and encapsulated and three subapical and bearing one spinule each); galea digitiform and bearing two apical sensilla. Labrum very thick, short, broad and feebly bilobed; anterior surface densely spinulose, spinules in transverse rows; each palp with five sensilla (two apical and encapsulated, three lateral and with one spinule each); isolated sensillum between each palp and opening of sericteries, latter a transverse slit. Hypopharynx densely spinulose, spinules long and in numerous transverse rows. (Material studied: six larvae from New South Wales, courtesy of Rev. B. B. Lowery.) In alcohol mature larvae cling to each other by means of the interlocked hairs.

Tribe DACETINI

Our latter-day taxonomists say that we should use all possible kinds of characters in classification. Here is a possible chemical character of the tribe Dacetini: when larvae are cleaned in 10% KOH, the insoluble meconium turns red. We have found this to be true of the following species: *Colobostruma* sp., *Epopostruma alata*, *E. quadrispinosa*, *Mesostruma browni*, *Orectognathus antennatus*, *O. mjobergi*, *O. nigriventris*, *Strumigenys perplexa*.

←

×18; b, head in anterior view, ×88; c, left mandible in anterior view, ×177; d, e, two types of body hairs, ×267. FIG. 4.—*Strumigenys perplexa*. Left mandible in anterior view, ×290.

Genus ACANTHOGNATHUS Mayr

G. C. and J. Wheeler (1969: 110).—Generic characterization.

Wilson (1962: 414).—The danger of piercing the skin of the larvae is avoided thus: “a pair of small teeth near the base of the mandibles are used to grip and carry brood, thus by-passing the apical teeth (Mann, 1922: later confirmed by W. L. Brown, *in litt.*, 1961).” But we can find no such statement in Mann (1922).

ACANTHOGNATHUS RUDIS Brown and Kempf

G. C. and J. Wheeler 1969: Description and figures.

Genus COLOBOSTRUMA Wheeler

Profile orectognathiform. Anus with a small posterior lip. Head large. Body hairs sparse and short; of two types: (1) smooth, deeply bifid with the tips curling away from each other and (2) unbranched and denticulate. Frons and clypeus bulging. Antennae small. Head hairs few and short to long; unbranched and either smooth or denticulate. Mandibles leptothoraciform.

In our 1960b key the genus *Colobostruma* runs to *Orectognathus*, from which it can be distinguished by the lack of denticles on its bifid hairs.

COLOBOSTRUMA sp.

(Fig. 2)

Length (through spiracles) about 2.1 mm. Profile orectognathiform (i.e., abdomen rather stout, diameter greatest at AIV and AV, attenuated anteriorly; thorax rather slender and curved ventrally, forming indistinct neck; posterior end broadly rounded). Head large. Anus ventral, with posterior lip. Leg, wing and gonopod vestiges present. About ten differentiated somites. T2 spiracle about twice diameter of remainder. Integument of entire venter and of dorsal surfaces of posterior somites with minute spinules in short transverse rows, elsewhere spinules minute and isolated. Body hairs sparse and short. Of two types: (1) 0.044–0.125 mm long, curved and denticulate, on ventral and lateral surfaces of thorax and AI-AVIII and on all surfaces of AIX and AX: (2) about 0.14 mm long, smooth, deeply bifid, branches strongly divergent and tips curled, on dorsal and lateral surfaces of all somites except AIX and AX. Cranium subhexagonal; frons and clypeus bulging. Antennae small, each with three sensilla, each bearing one rather long spinule. Head hairs few, 0.03–0.15 mm long, smooth or with minute denticles. Labrum feebly bilobed; narrowed dorsally; each lobe with three minute hairs and—medially—minute spinules in short transverse rows on anterior surface, with one isolated and two contiguous sensilla and numerous spinules on ventral border, with four isolated and three contiguous sensilla on posterior surface; entire posterior surface densely spinulose, spinules minute and in numerous

short transverse rows. Mandibles leptothoraciform (i.e., moderately narrow; tapering gradually and curving gradually to apical tooth; anterior surface produced medially into blade which bears two subapical teeth), the teeth large and directed medially. Maxillae large, lobose and adnate; each palp a skewed peg with four apical and one lateral sensilla; each galea digitiform, with two apical sensilla. Labium thick; anterior surface spinulose, spinules minute and in transverse rows; each palp a short frustum, with four apical and one lateral sensilla; isolated sensillum between each palp and opening of sericteries, latter a transverse slit. Hypopharynx densely spinulose, spinules rather long and in numerous subtransverse rows, rows so close together that spinules overlap. (Material studied: eight larvae from New South Wales, courtesy of Rev. B. B. Lowery.)

Genus DACETON Perty

Brown and Wilson (1959: 290).—“*Daceton* possesses, in addition to truly primitive features, characters that appear to represent significant specializations away from the main line of dacetine evolution, viz., in sculpturing, worker polymorphism, cephalic articulation, and larval morphology (see Brown 1953a; and Wheeler and Wheeler, 1954).”

DACETON ARMIGERUM (Latreille)

The mature workers of this species are highly polymorphic; the mature worker larvae range from 7 mm to 12 mm in length (through spiracles). Sexual larvae are 12.3–12.9 mm (through spiracles); the head hairs about twice as numerous, otherwise very similar to the worker larva. (Material studied: numerous larvae from Buenos Aires—25 km S. of Pucallpa, Peru.) Wilson (1962: 413–414) discussed brood care, feeding, and transport in this species.

Genus EPOPOSTRUMA Forel

EPOPOSTRUMA ALATA Forel

Length (through spiracles) about 3.3 mm. Very similar to *E. sp.* (1954: 128), except in following details. Integument of venter and of dorsal surface of posterior somites with minute spinules in short transverse rows, elsewhere spinules shorter and less numerous. Body hairs: (1) 0.038–0.125 mm long; (2) 0.075–0.163 mm long. Head hairs longer (0.075–0.175 mm long). Mandibles stouter and with medial teeth larger and directed more nearly medially. (Material studied: eight larvae from New South Wales, courtesy of Rev. B. B. Lowery.)

EPOPOSTRUMA FROSTI (Brown)

Length (through spiracles) about 5.3 mm. Very similar to *E. sp.* (1954: 128) except as follows. Thorax and AI more slender. Anus with posterior lip. Integument of venter of neck and of dorsal surface of posterior somites with minute spinules in short transverse rows. Body hairs more numerous. Of three types:

(1) 0.05–0.125 mm long, few, with single shaft and few denticles, on venter of anterior somites; (2) 0.075–0.15 mm long, with denticulate hooked tip, on remainder of venter of abdomen; (3) 0.05–0.4 mm long, with short-bifid tip, branches sparsely denticulate, on dorsal and lateral surfaces of all somites. Cranium with straight sides. Head hairs 0.03–0.125 mm long, usually with few denticles. Mandibles with apex more curved, teeth larger and more widely separated. (Material studied: 14 larvae from South Australia, courtesy of Rev. B. B. Lowery.)

EPOPOSTRUMA QUADRISPINOSA Forel

Length (through spiracles) about 4.0 mm. Very similar to *E. sp.* (1954: 128) except as follows. Body hairs (1) 0.05–0.125 mm long, unbranched, with hooked tip, on venter of each somite; (2) 0.05–0.125 mm long. Head hairs 0.025–0.125 mm long. Mandibles with apex more curved, teeth larger and more widely separated. (Material studied: 15 larvae from New South Wales, courtesy of Rev. B. B. Lowery.)

Genus MESOSTRUMA Brown

Profile aspididriiform. Body hairs sparse. Of two types: (1) with single denticulate shaft; (2) deeply bifid, with branches denticulate. Head hairs sparse and smooth or with a few denticles. Mandibles leptothoraciform, with two medial teeth.

In our 1960b key *Mesostruma* would run to *Alistruma* from which it can not be separated at present. We are giving below a complete description of *M. browni*, because we regard *M. laevigatus*, which we described (1954: 130), as a sexual larva.

MESOSTRUMA BROWNI Taylor

(Fig. 3)

Length (through spiracles) about 4.0 mm. Profile aspididriiform (i.e., moderately stout; no neck, but thorax and first two abdominal somites strongly curved ventrally; diameter greatest at AV, decreasing to AI, then increasing slightly to T2, decreasing rapidly to diameter of head; dorsal profile C-shaped, ventral J-shaped; anus ventral). Anus without lip. Spiracles small, T2 largest. Integument of venter of anterior somites and dorsa of posterior somites with minute spinules in short transverse rows. Body hairs sparse. Of two types: (1) 0.038–0.125 mm long, on all surfaces of AX and on venter of remaining somites, single shaft with minute denticles; (2) 0.063–0.15 mm long, deeply bifid, with branches denticulate, on dorsal and lateral surfaces of all somites except AX. Cranium subhexagonal in anterior view, as broad as long; occiput feebly concave. Antennae very small, each with three sensilla, each bearing a rather long spinule. Head hairs few, 0.025–0.125 mm long, smooth or with few denticles. Labrum small; breadth twice length; subrectangular, with ventral corners rounded, medial border feebly concave; each lobe with three or four sensilla on anterior surface near ventral border, with cluster of three sensilla on ventral border and with three contiguous sensilla on posterior surface; entire posterior surface spinulose, spinules minute, dorsal stouter and ventral finer. Mandibles leptothoraciform (i.e., moderately narrow;

tapering gradually and curving gradually to apical tooth; anterior surface produced medially into blade with two subapical teeth). Maxillae short and lobose; palp chair-shaped, with one lateral (bearing spinule) and four apical (two encapsulated and two bearing one spinule each) sensilla; galea a frustum with two apical sensilla. Labium with numerous short rows of minute spinules on anterior surface; palps similar to maxillary palps, but shorter; isolated sensillum between each palp and opening of sericteries; the latter a transverse slit. Hypopharynx with few short arcuate rows of spinules. (Material studied: six larvae from Canberra, ACT, courtesy of Rev. B. B. Lowery.)

Genus NEOSTRUMA Brown

NEOSTRUMA MUSTELINA (Weber)

Brown 1959: 9—"In one natural nest, an entomobryid was found with larvae feeding on it."

Genus ORECTOGNATHUS Mayr

ORECTOGNATHUS ANTENNATUS F. Smith

Length (through spiracles) about 4.2 mm. Similar to *O. clarki* (1954: 126) except as follows. Neck more slender, remainder of abdomen more swollen. Body hairs (1) 0.05–0.2 mm long, longer with fewer denticles and tending toward single hook dorsally, ventrally shorter and more denticulate, flexuous; (2) 0.06–0.15 mm long, few, deeply bifid, with few denticles on each branch. Cranium subrectangular, with dorsal border feebly concave. Head hairs shorter (0.025–0.125 mm long). Labrum broader ventrally; ventral border of each lobe with two isolated and two contiguous sensilla. Each mandible with apical tooth sharper and medial teeth larger. (Material studied: seven larvae from New South Wales, courtesy of Rev. B. B. Lowery.)

ORECTOGNATHUS MJOBERGI Forel

Length (through spiracles) about 4.2 mm. Similar to *O. clarki* (1954: 126) except as follows. Body hairs of two types: (1) 0.025–0.075 mm long, bifid with branches denticulate, on dorsal and lateral surfaces of all somites; (2) 0.06–0.24 mm long, with single denticulate shaft (sometimes with denticulate side branch), largely confined to the venter but with transverse band around middle of each somite. Cranium subrectangular, with occiput feebly concave. Entire posterior surface of labrum spinulose, spinules minute and in short transverse rows. (Material studied: numerous larvae from New South Wales, courtesy of Rev. B. B. Lowery.)

ORECTOGNATHUS NIGRIVENTRIS Mercovich

IMMATURE LARVA.—Length (through spiracles) about 2.5 mm. Similar to *O. clarki* (1954: 126) except as follows. Body hairs of three types: (1) 0.05–0.25 mm long, shortest ventrally, slightly curved to flexuous, with minute denticles; (2) 0.1–0.3 mm long, deeply bifid, few on dorsal and lateral surfaces of each somite;

(3) about 0.3 mm long, uncinata, with flexuous shaft, two to six on T2-AX. Head very large. Head hairs 0.025-0.275 mm long, slightly curved and smooth or with few denticles. (Material studied: numerous immature larvae from New South Wales, courtesy of Rev. B. B. Lowery.)

ORECTOGNATHUS ROSTRATUS Lowery

Length (through spiracles) about 3.5 mm. Similar to *O. clarki* (1954: 126) except as follows. Integument of venter of anterior somites and of dorsum of AX with minute spinules in short transverse rows. Body hairs (1) 0.06-0.18 mm long, bifid, with denticles; (2) 0.025-0.23 mm long, on ventral surface; (3) about 0.3 mm long, with stout shaft and small single hook, two on dorsum of each AI-AV. Cranium subrectangular but with occipital border feebly concave. Head hairs 0.025-0.175 mm long, slightly curved and usually with few denticles. (Material studied: six larvae from New South Wales, courtesy of Rev. B. B. Lowery.)

Genus STRUMIGENYS F. Smith

STRUMIGENYS PERPLEXA F. Smith

(Fig. 4)

Length (through spiracles) about 1.9 mm. Similar to *S. louisianae* (1954: 136) except as follows. Body hairs shorter: (1) 0.025-0.06 mm long, on venter of each somite; (2) 0.038-0.1 mm long; (3) about 0.15 mm long. Head hairs shorter (0.013-0.075 mm long). Labrum with breadth only 1½ times length. Mandibles with all teeth blunter, medial teeth small, close together and divergent. Maxillary palp represented by cluster of three sensilla. Each labial palp represented by cluster of four sensilla. (Material studied: numerous larvae from New South Wales, courtesy of Rev. B. B. Lowery.)

LITERATURE CITED

- BROWN, W. L. 1959. A revision of the dacetine ant genus *Neostruma*. *Breviora*, No. 107, 13 p.
- BROWN, W. L., AND W. W. KEMPF. 1960. A world revision of the ant tribe Basicerotini. *Stud. Entomol.*, 3: 161-250.
- BROWN, W. L., AND E. O. WILSON. 1959. The evolution of the dacetine ants. *Quart. Rev. Biol.*, 34: 278-294.
- MANN, W. M. 1922. Ants from Honduras and Guatemala. *Proc. U. S. Nat. Mus.*, 61: 1-54.
- WHEELER, G. C. AND J. WHEELER. 1954. The ant larvae of the myrmicine tribes Basicerotini and Dacetini. *Psyche*, 61: 111-145.
- 1960a. Supplementary studies on the larvae of the Myrmicinae. *Proc. Entomol. Soc. Wash.*, 62: 1-32.
- 1960b. The ant larva of the subfamily Myrmicinae. *Ann. Entomol. Soc. Amer.*, 53: 98-110.
1969. The larvae of *Acanthognathus*. *Psyche*, 76: 110-113.
- WILSON, E. O. 1962. Behavior of *Daceton armigerum* (Latreille), with a classification of self-grooming movements in ants. *Bull. Mus. Comp. Zool. Harvard Coll.*, 127: 404-421.

The Genus *Polynemoidea* Girault

(Hymenoptera: Mymaridae)

RICHARD L. DOUTT¹

University of California, Berkeley

The finding of a fossil species of *Polynemoidea* in Oligocene amber from Chiapas, Mexico, and the recognition of a synonymous genus from Tasmania has motivated this synopsis.

POLYNEMOIDEA Girault

Polynemoidea Girault, A. A. 1913. Mem. Queensland Mus., 2: 116.

Selenaeus Waterhouse, C. O. 1914. Trans. Entomol. Soc. London, 1914 pp. 536-537. (*New synonymy*).

Type of genus: *Polynemoidea varicornis* Girault

Polynemoidea varicornis Girault, A. A. 1913. Mem. Queensland Mus., 2: 116.

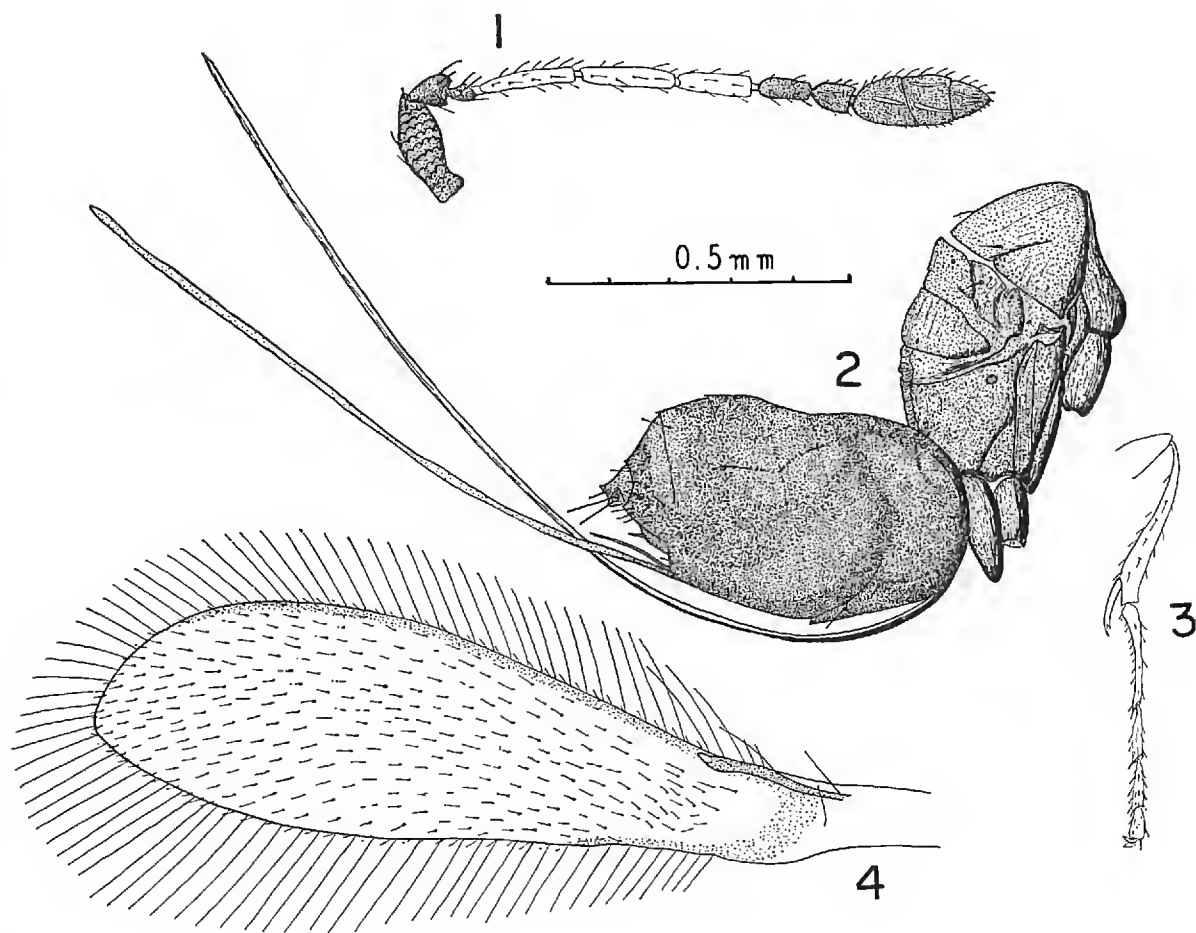
Selenaeus turneri Waterhouse, C. O. 1914. Trans. Entomol. Soc. London, 1914, p. 537. (*New synonymy*).

The type species, *P. varicornis* Girault, was described from a female collected at Hobart, Tasmania. I have not seen this specimen which is reportedly in the South Australian Museum at Adelaide under type number I. 1228. However, I have examined two female specimens in the Girault collection at the Queensland Museum, Brisbane. These are together on one slide. The labels are in Girault's handwriting and one reads "*Polynemoidea varicornis* Girault ♀ Cotype." The word "Type" is above the word "Cotype" but is crossed out. The other label reads "Bred from wood. Hobart, Tas. H. W. Lea." Since a type was designated it is highly probable that these two female specimens are paratypes. They are from the same locality (Tasmania) as the type and certainly fit the original description.

The species *P. varicornis* is very distinct from the other members of the genus in several respects. The scape is serrated; funicle segments 2, 3 and 4 are remarkably elongate and much lighter in color than other antennal segments (Fig. 1). The ovipositor is greatly exerted (Fig. 2). The first tarsal segment is especially long (Fig. 3), and the forewings tend to be pointed (Fig. 4). In body size it is the largest species in the genus.

It is interesting that a single mymarid female also collected in Tasmania was described as *Selenaeus turneri* Waterhouse. This specimen

¹ Present address: 9240 S. Riverbend Avenue, Parlier, California 93648.



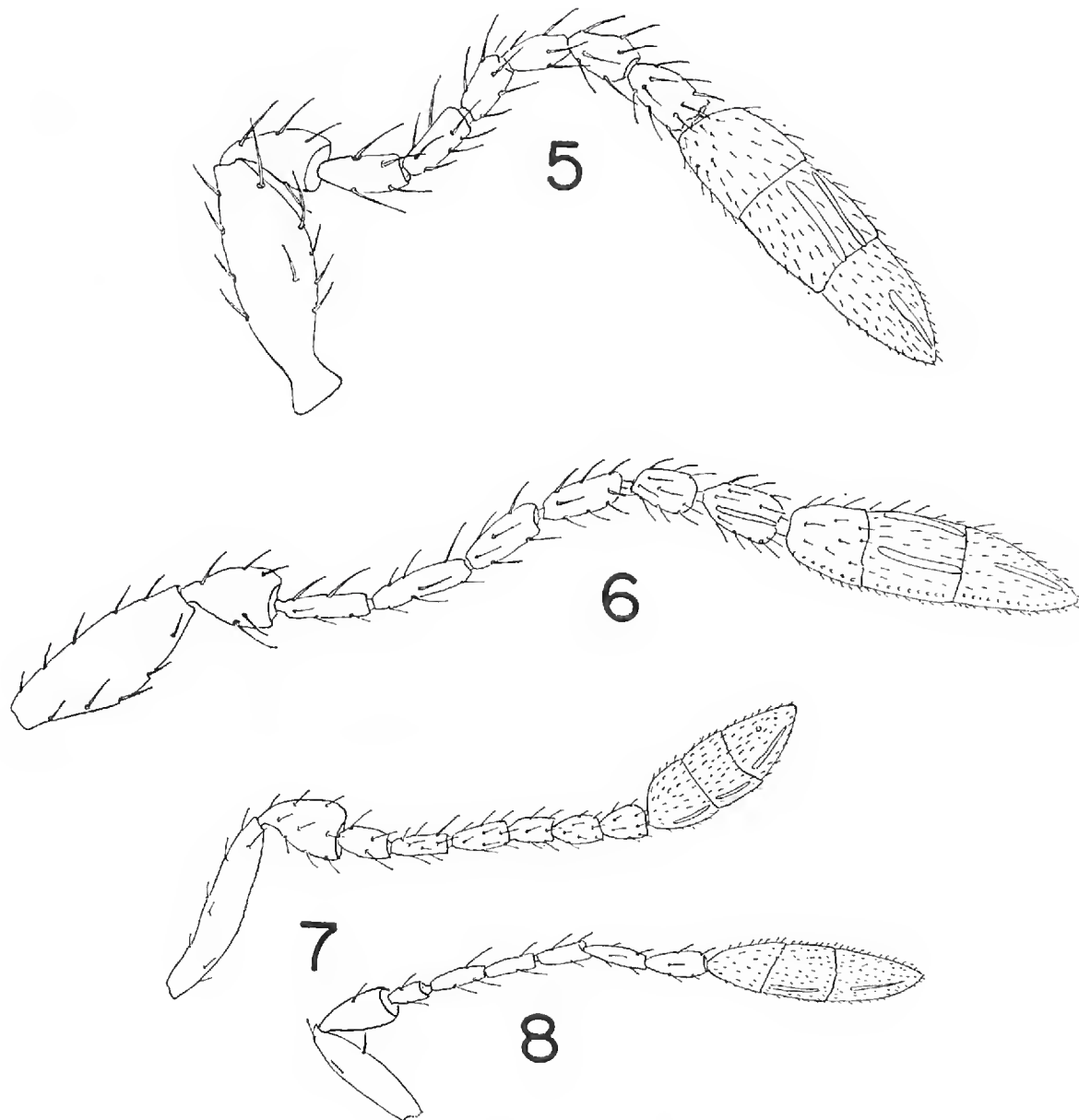
FIGS. 1-4. *Polynemoidea varicornis*. FIG. 1. Antenna. FIG. 2. Body proportions. FIG. 3. Fore tibia and tarsi. FIG. 4. Forewing.

is in the British Museum (Natural History), London, and is identical with *P. varicornis* Girault. This synonymous species was thought by the collector to be associated with some homopterous galls, but there is so far no definite host relationship established for any species in the genus *Polynemoidea*.

POLYNEMOIDEA LINCOLNI Girault

Polynemoidea lincolni Girault, A. A. 1913. Mem. Queensland Mus. 2: 116-117.

The type specimen is a single female collected by sweeping jungle vegetation, Nelson (Cairns) Queensland, July 10, 1913 (A. P. Dodd). The original description is accurate except that all the funicle segments are dark and segments 1 and 2 are subequal (Fig. 5). The ovipositor originates at the base of the abdomen and is slightly exerted. The wings are broad (Fig. 9). The thorax is without sculpturing and the dark brown or black mesoscutum strikingly contrasts with the yellow scutellum and propodeum. The eyes and head are black. The mandibles have two teeth and a blunt truncation.

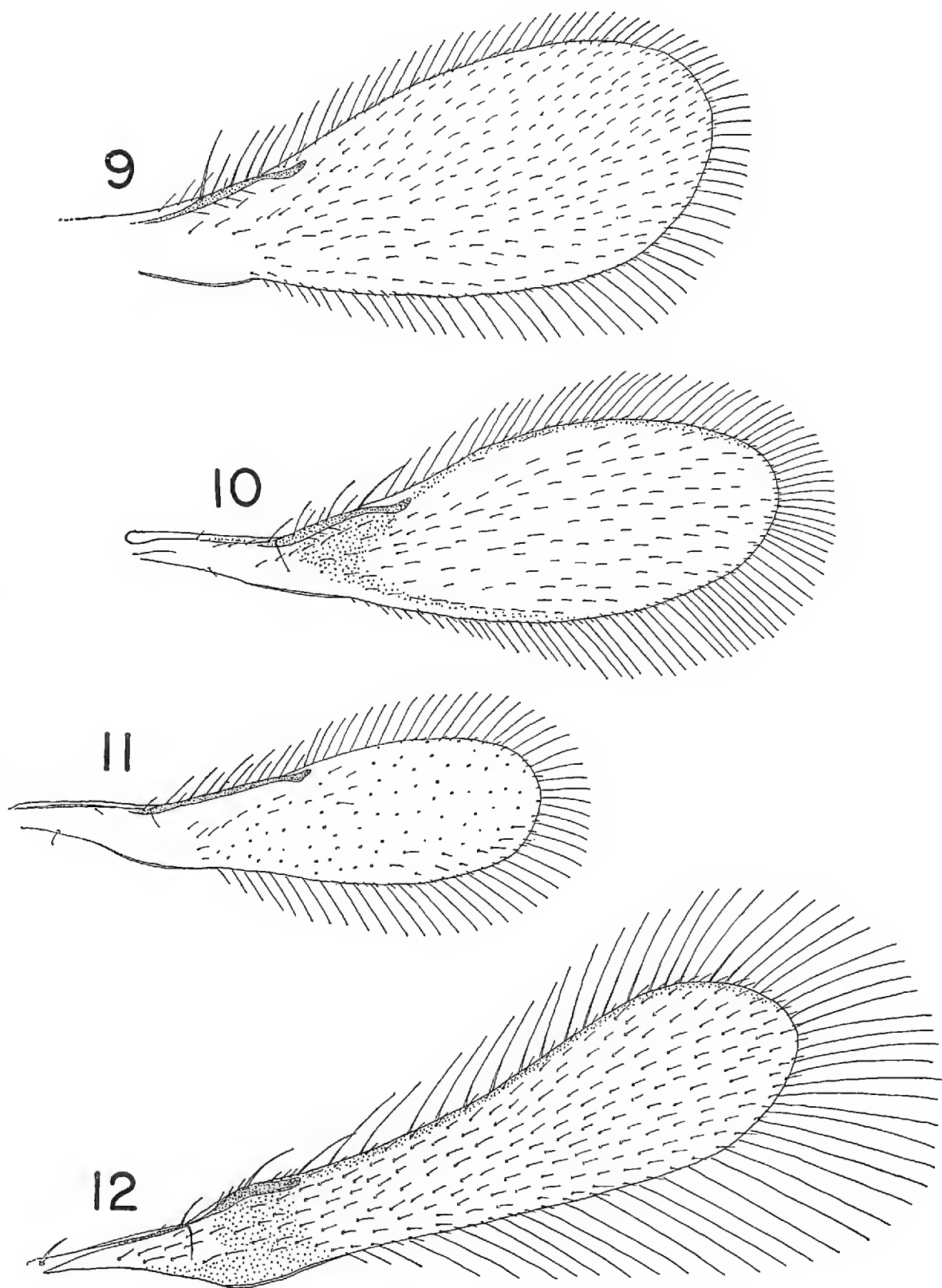


FIGS. 5-8. Antennae. FIG. 5. *Polynemoidea lincolni*. FIG. 6. *P. particoxae*. FIG. 7. *P. domestica*. FIG. 8. *P. mexicana*.

POLYNEMOIDEA PARTICOXAE Girault

Polynemoidea particoxae Girault, A. A. 1938. Rev. Entomol. (Rio de Janeiro), 9: 390-391.

This species is related to *P. lincolni* but funicle segments 1 and 2 are somewhat more slender (Fig. 6) and the forewing is narrower (Fig. 10). The head is black, eyes purplish black. The mandibles have 3 distinct teeth. The scutum and scutellum are black, the propodeum is yellow. The forecoxae are dark but the middle and hind pairs are light, trochanters pale, femora dark, tibia and tarsi light. The abdomen is short, dark; the ovipositor originates at base of abdomen and is only slightly exerted. Both *P. lincolni* (Fig. 9) and *P. particoxae* (Fig. 10) have forewings with long, slender marginal and stigmal veins.



FIGS. 9-12. Forewings. FIG. 9. *Polynemoidea lincolni*. FIG. 10. *P. particoxae*. FIG. 11. *P. incerta*. FIG. 12. *P. domestica*.

POLYNEMOIDEA INCERTA Girault

Polynemoidea incerta Girault, A. A. 1938. Rev. Entomol., Rio de Janeiro, 9: 391.

The type specimen is a fragmented male. The antennal clubs are missing. There are eleven flagellar segments present on one antenna. The marginal vein is extraordinarily long for this genus (Fig. 11). This single male is doubtfully retained in this genus although it does belong in the Tribe Anaphini.

POLYNEMOIDEA DOMESTICA Girault

Polynemoidea domestica Girault, A. A. 1931. A new habit in an old insect, *Homo pudicus* and new Eurytomidae. Privately published, Brisbane, Australia, 4 pp. (p. 3).

The type specimen is a single fragmented female collected on a window of Girault's home, Indooroopilly, Queensland, 1929. The body is dark brown, legs lighter brown. Eyes crimson. Antenna as in Fig. 7, scape slender. Scutum with distinct reticulate sculpturing. Wings with short marginal and stigmal veins (Fig. 12).

***Polynemoidea mexicana* Doult, new species**

FEMALE.—Body, viewed laterally, compressed, hypogynium absent. Thorax elongate, about equal to abdomen. Color golden brown. Head with very short dimension on anterior-posterior axis, but very long dimension on dorsal-ventral axis. Antennae as in Fig. 8. Scape moderate length, normal; pedicel somewhat enlarged, elongate. Six funicle segments, first is smallest, increasing in width distally. Club distinctly 3-segmented, long. One antenna with segments somewhat compressed (possibly artifact of fossilization process). Legs normal, wing characteristics mostly hidden by bubbles and fractures in amber block, but discal ciliation similar to *P. domestica*. Ovipositor exerted but not remarkably so, thus similar to *P. domestica*, but with different antennal characters.

Holotype female, LAS CRUCES LANDSLIDE, CHIAPAS, MEXICO.

Described from single female embedded in amber. This specimen is at the University of California Museum of Paleontology and has the type number 12865, loc. B-5104 (1957). The B-5104 amber is from the Las Cruces landslide, Chiapas, Mexico. This locality is about 23 km (airline) east-southeast of the town of Simojovel, about 6.8 km south-east of the headquarters of the Rancho Santo Domingo, about 1.4 km northwest of Rancho San José de Buenavista. The landslide is on the south slope, near the southeast end of the major ridge known locally as Nichcalan (also as Cerro Balumtun). The amber was found in a dense blue limestone near the base of the slide. The marine invertebrate fauna from adjacent beds indicates an age in the range from late Oli-

gocene to early Miocene. (This locality description from Fennah, R. G. 1963. U. C. Publ. Entomol. 31(1) : 45.)

KEY TO FEMALES OF AUSTRALIAN SPECIES OF POLYNEMOIDEA

1. Ovipositor very long, scape asperate, basal tarsal segments much longer than any succeeding segments *varicornis* Girault
 Ovipositor not long, only slightly exerted, scape not asperate 2
2. Thorax with coarse, reticulate sculpturing, thorax entirely dark brown, ovipositor originating in middle of abdomen *domestica* Girault
 Thorax without coarse, reticulate sculpturing, thorax black and yellow, ovipositor originates at base of abdomen 3
3. Mandibles with three distinct teeth, mesoscutum and scutellum black, metathorax yellow, forecoxae dark, middle and hind coxae pale
 *particoxae* Girault
 Mandibles with two teeth and blunt truncation, mesoscutum black, scutellum and propodeum yellow, all coxae pale *lincolni* Girault

RECENT LITERATURE

A series of paperbacks dealing with environmental problems have been received from the publisher, Houghton Mifflin Company, Boston (no price information was included). The first three are collections of reprinted articles by many environmentalists including such well known ecologists and entomologists as: J. Ralph Audy, Barry Commoner, Paul R. Ehrlich, Frank E. Engler, and Eugene P. Odum. The fourth book deals with the DDT controversy.

ENVIRON/MENTAL. ESSAYS ON THE PLANET AS A HOME. Edited by Paul Shepard and Daniel McKinley. 308 p., illus., 1971.

The emphasis of this book is on the human overpopulation problem and its social and psychological effects on man. Each of the 20 reprinted articles is preceded by a brief introduction by the editors and concludes with a set of references. The book concludes with biographical notes on the authors and an extensive list of additional readings.

THE POLITICS OF NEGLECT: THE ENVIRONMENTAL CRISIS. Edited by Roy L. Meek and John A. Straayer. 256 p., 1971.

The 28 reprinted articles are arranged into six chapters considering problems from population to pollution. Each chapter is preceded by an introductory statement by the editors. Tables, footnotes, figures and references are omitted from the articles, but a terminal bibliography of general references is provided.

The Fossil Mymaridae

(Hymenoptera: Chalcidoidea)

RICHARD L. DOUTT¹

University of California, Berkeley

The Mymaridae are very minute wasps which develop solely as primary parasitoids within the eggs of other insects. The fossilized specimens found in amber are very similar morphologically to species living today, and it is probable that the fundamental habits of the mymarids as parasitoids have remained unchanged for at least 30,000,000 years. These small insects are frequently found entangled in sticky material placed on boards suspended in trees, so it is understandable how their general search for hosts in arboreal habitats could easily have led to occasional entrapment in gums or resins, and thus eventually to fossilization in amber.

The Mymaridae were first recognized as fossils in amber by Loew in 1847. They have been found in Canadian (Cretaceous), Baltic (early Oligocene), Mexican (late Oligocene and early Miocene), and Sicilian (Miocene) ambers. Species have also been described from the recent copal of Madagascar and Zanzibar. This paper includes comments on all of the known fossil members of this interesting family of chalcids, but it is primarily concerned with a series of Mymaridae found in late Oligocene or early Miocene amber from the Simojovel area, Chiapas, Mexico. According to Langenheim (1969) the leguminous genus *Hymenaea* is the probable source of the Chiapas amber. The modern species, *H. courbaril*, is known for its abundant secretion of resin that accumulates in the soil around the tree. Langenheim states that in Mexico today, *H. courbaril* grows commonly along rivers that enter the ocean in mangrove-fringed estuaries. It is believed that the Chiapas amber was deposited in such an estuarine environment.

According to the classification proposed by Annecke and Doutt (1961), the family Mymaridae consists of two subfamilies and five tribes. Both subfamilies are well represented in the fossil record (Appendix). However, most of the fossil species in each subfamily are in a single tribe. In each case, Alaptini and Ooctonini, all members of the tribe are characterized by possessing five tarsomeres. This is a more primitive condition than the four tarsomere formula exhibited by members of the other tribes in each subfamily. Of the 16 species

¹ Present address: 9240 S. Riverbend Avenue, Parlier, Ca. 93648.

recognized in the fossil record only *Alaptus globosicornis* Girault, *Alaptus psocidivorus* Gahan, and *Palaeomyrmar duisburgi* (Stein) are known to be extant.

Subfamily ALAPTINAE

Genus ALAPTUS Westwood

The species of *Alaptus* are noteworthy because of their minuteness. Adult specimens of these wasps usually do not exceed 0.3 mm in total length, and are among the smallest of all known insects. The few species of *Alaptus* which have been studied biologically develop within the eggs of Psocoptera.

In 1909 Meunier found and described an *Alaptus* in recent copal from Zanzibar. This first account of a fossilized *Alaptus* is based on a single male specimen for which Meunier proposed the name *Alaptus fructuosus*. It is difficult to compare this species with existing forms because Meunier's description is inadequate in certain critical details, and our present system of classification is based primarily on female rather than on male characters. Therefore the correct placement of any *Alaptus* male at the species level is largely speculative.

The series of Myrmaridae in the Simojovel amber contains at least two species of *Alaptus*. There are four female specimens (University of California Museum of Paleontology numbers 12773, B-1402; 12778, B-1402; UCMP 12631, B-4112; and UCMP 12632, B-4117) which are indistinguishable from *Alaptus psocidivorus* Gahan, a species which exists today in California as a parasite of the psocid, *Peripsocus californicus* Banks, on Toyon, *Heteromeles arbutifolia* M. Roem.

One female *Alaptus* (UCMP 12897, B-5106) is morphologically very close to the species *A. globosicornis* Girault. Although the first funicle segment is longer than typical *A. globosicornis*, and the general habitus is less compact, these differences are insufficient to justify naming this single specimen as a representative of a new species. This conservative view is justified because *A. globosicornis* appears to be a highly variable species, and Girault (1912) not only indicated that modifications in the original description of the species were necessary but that at least two "varieties" existed, which he termed *hawaiiensis* and *australiensis*. One specimen in the present series of fossil *Alaptus* (UCMP 12633, B-7043) is difficult to place, but it is probably also *A. globosicornis* or closely related.

There are five male *Alaptus* in the Simojovel amber that seem to represent two species. Two specimens are very dark colored and have

comparatively short antennal segments (UCMP 12898, B-5106 and UCMP 12634, B-7041). The other specimens (UCMP 12625; UCMP 12636, B-4112; and UCMP 12638, B-4112) are light brown in color with more elongate legs and antennae. It is possible that these males relate respectively to *A. globosicornis* and *A. psocidovor*, but there is no way at present to associate them with certainty.

Genus LITUS Haliday

Meunier (1901) described *Litus elegans* from a female found in Baltic (early Oligocene) amber, and later (1909) he described *Litus beneficus* from the recent copal of Madagascar. The Simojovel amber contains one female *Litus* which is distinctly different from Meunier's species, and is also unlike any of the species which are known to exist today. It is described as follows:

Litus mexicanus Doutt, new species

FEMALE.—Length 0.54 mm. Antenna as in Fig. 1. Scape long, moderately expanded, funicle segments heavily setaceous, segments 2 to 6 each with single short paddle-shaped structure located dorsally and apically, club large, elongate, with many short setae. Head distorted in this specimen but ommatidia large. Condition of thorax precludes analysis of surface sculpturing. Basitarsal segment of foreleg long, strigil prominent, calcar large, stout, curved and bifid. Middle legs long and slender. All tibiae with strong setae. Forewings broken but general shape and venation normal for genus. Hindwing maculate, with single line of small discal setae. Ovipositor originates at base of abdomen, large, prominent, markedly exserted.

The expanded scape, paddle-shaped sensoria, and the strongly developed and exserted ovipositor distinguish *L. mexicanus* from other species of *Litus*.

The type specimen is in the University of California Museum of Paleontology, Berkeley, with the UCMP number 12812, B.-7041. From Oligocene amber, Chiapas, Mexico.

Species of *Litus* occur today in South America and in the Caribbean area, but this fossil is the first record from Mexico. The true host relationships of *Litus* are not known, although *L. cynipseus* Haliday was found in a colony of the ant, *Lasius niger*, where it may have been parasitizing eggs of coleopterous myrmecophiles.

Genus Malfattia Meunier

Meunier (1901) described this genus from a single specimen with four segmented tarsi and nine segmented antennae. The genus has

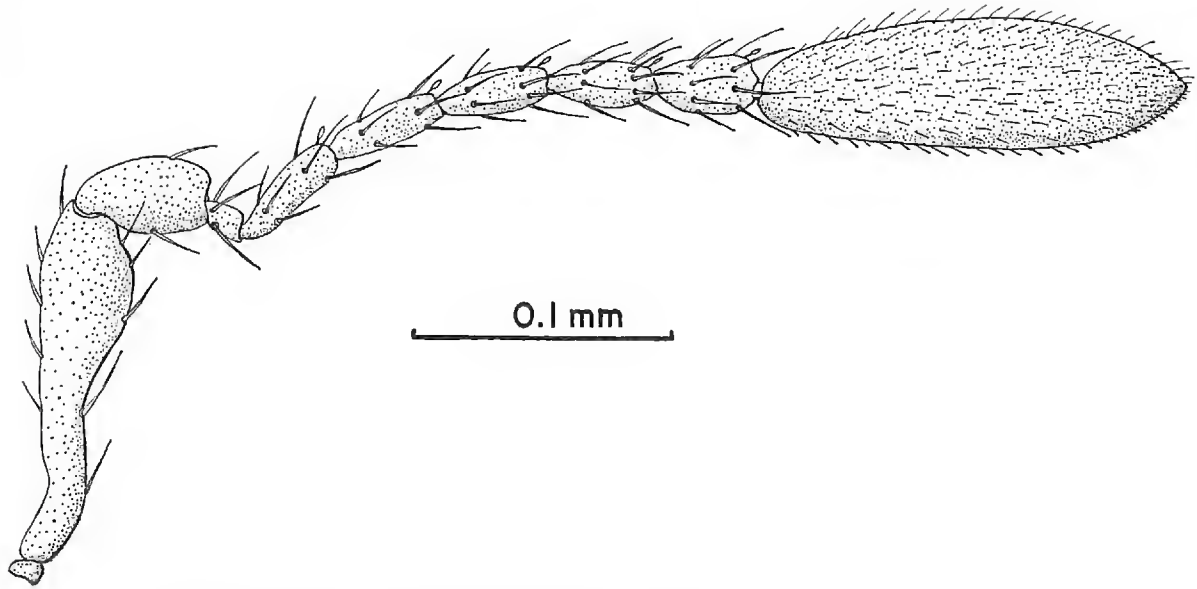


FIG. 1. Female antenna of *Litus mexicanus* Doult.

been synonymized with *Litus* by Ashmead (1904) although he doubted whether this was correct. The four segmented tarsi would make such placement erroneous. Meunier believed that his specimen was related to one from Sicilian amber discussed by Malfatti, and accordingly named it in his honor. *Malfattia* remains as a very poorly known and doubtfully placed genus until Meunier's specimen can be re-examined.

Subfamily MYMARINAE

Genus LYMAENON Walker

The species *Lymaenon henneberti* (Meunier) described from Baltic amber in 1905 is the only known fossil in this genus. There are many modern species in *Lymaenon* (formerly *Gonatocerus*), and they attack a wide variety of hosts in many different habitats.

Genus ARESCON Walker

Meunier (1901, 1905) described two species of fossil Mymaridae in the genus *Leimacis*, but properly they should be placed in the genus *Arescon*. Both species, *Arescon armata* (Meunier) and *A. baltica* (Meunier) are from Baltic amber. Nothing is known of the host relationships of our modern species.

Genus OOCTONUS Haliday

Brues (1937) found a Mymarid in Canadian amber which he described as *Ooctonus* (?) *minutissimus* but gave no indication why he believed the generic placement to be doubtful. This specimen is Cre-

taceous, and is therefore the oldest known fossil member of the family. *Ooetonus* is reared from eggs of leafhoppers and is not considered to be a primitive form.

Genus PALAEOMYMAR Meunier

Palaeomyrmar Meunier, 1901. Ann. Soc. Sci. Bruxelles. 25(2): 288-289.

Type: *Palaeomyrmar duisburgi* (Stein) 1877, Mitt. München entomol. Ver. 1: 30. New Combination.

Palaeomyrmar succini Meunier, 1901, Ann. Soc. Sci. Bruxelles. 25(2): 289.

Petiolaria anomala Blood and Kryger, 1922. Entomol. Mon. Mag. 58: 229.

Mymaromma Girault, 1920. Insec. Inscit. Menstr. 8: 38. New synonym.

Type: *Mymaromma goethei* Girault.

Petiolaria Blood and Kryger, 1922. Entomol. Mon. Mag. 58: 229. New synonym.

Type: *Petiolaria anomala* Blood and Kryger.

Mymaromella Girault, 1931. A new habit in an old insect, *Homo pudicus* and new Eurytomidae. Privately published, Brisbane, Sept. 1, 1931. p. 4 New synonym.

TYPE.—*Mymaromella mira* Girault.

The above synonymy is solely the result of this comparative study of fossil Myrmaridae, and it has the virtue of solving the problem of the correct placement of *Palaeomyrmar* which has been troubling students of Myrmaridae for many years. The riddle began in 1868 when Duisburg described and illustrated, but did not name, a female Myrmarid in amber which he believed belonged to the genus *Mymar*. Later Stein (1877) in studying another specimen in amber believed that it agreed in all the essentials with Duisburg's insect and accordingly named it *Mymar Duisburgi*.

In 1901 Meunier placed *M. Duisburgi* Stein into the genus *Eustochus*, created the new genus *Palaeomyrmar* for five specimens of the series discussed by Duisburg in 1868, and stated that representatives of the genus *Mymar* were not known in the fossilized state.

In 1922 Blood and Kryger discovered a modern myrmarid of a very unusual type in England and Denmark. They designated it as a new genus and species, namely *Petiolaria anomala* Blood and Kryger. They were not aware that the same genus occurred in Australia and had been described there two years earlier as *Mymaromma* by Girault.

In 1948 Bakkendorf independently found the 1868 paper by Duisburg and correctly concluded that the amber insects seen and described therein were conspecific with *Petiolaria anomala* Blood and Kryger. Bakkendorf did not mention the works of Stein (1877) nor of Meunier (1901), but his recognition of Duisburg's specimen as *P. anomala*

was correct and has furnished the clue to the present placement of *Palaeomyrmar*. There is now ample evidence that the species pictured by Duisburg (1868), described and named by Stein (1877), discussed by Meunier (1901) under *Eustochus*, and identified by Bakkendorf (1948) as *Petiolaria anomala* Blood and Kryger is actually a single species, based on characters of the female sex. The males of this same species were not recognized as such by Meunier who instead proposed the genus *Palaeomyrmar* for them.

It is very probable that Meunier's specimens of *Palaeomyrmar* are identical with the males of *Mymaromma* (*Petiolaria*) *anomala*. One is especially convinced of this when Debauche's (1948) illustrations of the structural characters of *Mymaromma* are compared with the figures of the same structures published by Meunier (1901). The male antennae of *Mymaromma* are distinctive and these same unique features are seen in the antennae figured by Meunier for *Palaeomyrmar*. Similarly, the female antennae of *Mymaromma anomala* with its characteristic seven segmented funicle is mirrored in the figure given by Meunier for what he termed *Eustochus duisburgi*. Although Meunier's drawing of the forewing of *Palaeomyrmar* is not the best example of entomological draftsmanship it is nevertheless unmistakably the wing of the insect which has been known as *Mymaromma*.

The foregoing evidence seems sufficient to justify the proposed synonymy. It is of interest that *Palaeomyrmar* is well represented by a large series of specimens in the Chiapas amber at the University of California Museum of Paleontology. These specimens deserve very careful study.

Genus ANAPHES Haliday

This genus contains two fossil representatives which were described by Meunier (1901) from Baltic amber. These are *Anaphes schellwieni* and *A. splendens*.

The Mexican amber contains a male which is probably an *Anaphes*. This lone male in the Simojovel material can be placed only tentatively because the classification of the group is based upon female characters. The specimen with the UCMP number 12640, B-7046 is very dark, which is characteristic of many *Anaphes*, and it has the general habitus and wings of that genus.

Genus POLYNEMOIDEA Girault

Until its discovery in the Chiapas amber, no member of this genus had ever been found outside the southern hemisphere, and it is a genus

that is seldom seen by mymarid specialists today. The five extant species are all Australian, and the closely allied genera such as *Idiocentrus* and *Notomyrmar* are also antipodal. Thus the specimen in the Simojovel series is of considerable interest, and was described as *Polynemoidea mexicana* Doutt (1973). It bears the UCMP number 12865, B-5104.

ACKNOWLEDGMENT

I am grateful to Joseph H. Peck, Jr., Senior Museum Scientist, University of California Museum of Paleontology, for his considerable assistance with specimen data. This material was collected and prepared under NSF Grants NSF-G10705; NSF-G 20016.

APPENDIX

List of fossil Mymaridae with amber sources.

ALAPTINAE:

Alaptini

- Alaptus fructuosus* Meunier, 1909. Zanzibar copal, recent.
A. globosicornis Girault, 1912. Mexican, late Oligocene, early Miocene.
A. psocidivorus Gahan, 1927. Mexican, late Oligocene, early Miocene.
Litus beneficus Meunier, 1909. Madagascar copal, recent.
L. elegans Meunier, 1901. Baltic, early Oligocene.
L. mexicanus Doutt, 1973. Mexican, late Oligocene, early Miocene.

Anagrini

- Malfattia Molitorae* Meunier, 1904. Baltic, early Oligocene; Sicilian, Miocene.
 (This species is doubtfully placed in Anagrini)

MYMARINAE:

Ooctonini

- Arescon baltica* (Meunier), 1901. Baltic, early Oligocene.
A. armata (Meunier), 1905. Baltic, early Oligocene.
Lymaenon henneberti (Meunier), 1905. Baltic, early Oligocene.
Ooctonus minutissimus Brues, 1937. Canadian, Cretaceous.
Palaeomyrmar duisburgi (Stein), 1877. Baltic, early Oligocene.
Palaeomyrmar sp. (undetermined). Mexican, late Oligocene, early Miocene.

Anaphini

- Anaphes schellwieni* Meunier, 1901. Baltic, early Oligocene.
A. splendens Meunier, 1901. Baltic, early Oligocene.
Polynemoidea mexicana Doutt, 1973. Mexican, late Oligocene, early Miocene.
Anaphes sp. (undetermined). Mexican, late Oligocene, early Miocene.

LITERATURE CITED

- ANNECKE, D. P. AND R. L. DOUTT. 1961. The genera of the Mymaridae. Hymenoptera: Chalcidoidea. S. Afr. Dep. Agr. Tech. Serv. Entomol. Mem., 5: 1-71.
 ASHMEAD, W. H. 1904. Classification of the chalcid flies. Mem. Carnegie Mus., 1(4): 225-555.

- BAKKENDORF, O. 1948. A comparison of a mymarid from Baltic amber with a recent species, *Petiolaria anomala* (Micro-Hym.). *Entomol. Medd.*, 25: 213-218.
- BLOOD, B. N. AND J. P. KRYGER. 1922. A new mymarid from Brockenhurst. *Entomol. Mon. Mag.*, 8: 229-230.
- BRUES, C. T. 1937. Insects and arachnids from Canadian amber. *Univ. Toronto, Geol. Ser.*, 40: 44.
- DEBAUCHE, H. R. 1948. Étude sur les Mymarommidae et les Mymaridae de la Belgique (Hymenoptera Chalcidoidea). *Mem. Mus. Roy. Hist. Natur. Bruxelles* 108: 1-248.
- DOUTT, R. L. 1973. The genus *Polynemoidea* (Hymenoptera: Mymaridae). *Pan-Pac. Entomol.*, 49(3): In press.
- DUISBURG, V. 1868. Zur Bernstein-Fauna. *Schrift. Königl. Phys.-Ökon. Gesellsch. Königsberg.*, 9: 23-28.
- GIRAULT, A. A. 1912. Australian Hymenoptera Chalcidoidea—I. *Mem. Queensland Mus.*, 1: 123-124.
- LANGENHEIM, J. H. 1969. Amber: a botanical inquiry. *Science*, 163(3872): 1157-1169.
- MEUNIER, F. 1901. Contribution a la Faune des Mymaridae "ou Atomes Ailés" de l'Ambre. *Ann. Soc. Sci. Bruxelles*, 25: 282-292.
1905. Sur deux Mymaridae de l'Ambre de la Baltique. *Misc. Entomol., Rev. Entomol. Int.*, 13(1): 1-4.
1909. Sur deux Mymarinae du copal récent de Madagascar et de Zanzibar. (Hym.). *Bull. Soc. Entomol. France*, 1909, pp. 145-149.
- STEIN, J. P. E. F. 1877. Drei merkwürdige Bernstein-Insekten. *Mitt. Munch. Entomol. Ver.*, 1: 28-30.

BOOK REVIEW

AUSTRALIAN BUTTERFLIES. Charles McCubbin. Thomas Nelson (Australia) Ltd., Melbourne. 206 p., fully illustrated in color, xxxi. 1971. \$30.00. North American Distributor: Entomological Reprint Specialists.

This quarto size book is fully and beautifully illustrated with water color paintings by the author of the butterflies (Papilionoidea) and skippers (Hesperioidea) of Australia. Among the most valuable and distinctive aspects are the many color illustrations of immatures, food plants and habitats as well as descriptions of life history and behavior of these Australian Lepidoptera.

The introductory chapter includes valuable information for the amateur on classification, the position of Lepidoptera among insects, the general life history of butterflies and skippers, collecting and curating methods and materials.

This is an extremely important butterfly book with special appeal to all interested in exotic Lepidoptera and their natural history.—ROBBIN W. THORP, *University of California, Davis, 95616.*

***Macrobotus montanus* from California**

(Tardigrada: Macrobiotidae)

ALBERT A. GRIGARICK, ROBERT O. SCHUSTER AND ELIZABETH C. TOFTNER

University of California, Davis 95616

Macrobotus montanus Murray, 1910, previously unknown from California, was collected at Auburn, Placer County, California. It was the most common species of *Macrobotus* occurring in the moss *Pseudobraunia californica* (Lesg.) Broth. and the lichen *Parmelia flaventior* Stirton, both found growing on rocks and small trees.¹

The collections from which specimens of *M. montanus* were prepared for study were made in October and November of 1972. The tardigrades were washed from samples submerged in water for a few hours and recovered from a 325 mesh screen in a small amount of water. They were fixed in boiling 95% ethanol and either slide-mounted in Hoyer's or prepared for study by scanning electron microscopy. The latter specimens were dehydrated in absolute isopropanol, transferred to amyl acetate and critical-point dried using CO₂ at 980 psi. Specimens affixed to stubs with silver print were coated with 100Å each of silver followed by gold and were examined using the Cambridge Stereoscan electron microscope at the Davis Campus Facility for Advanced Instrumentation.²

Macrobotus montanus was described originally from specimens collected at 6,000 ft., Nun's Veil Mtn., New Zealand. Ramazzotti (1972) records the species from Africa, Europe, the Galàpagos Islands and North America. Individuals of this California population are re-described and illustrated in detail because the information obtained by electron microscopy is new and will allow more critical comparisons to be made with other populations.

The eggs of this species (Figs. 1A; 2C, D) are 77 μ to 87 μ in diameter and the hemispherical processes are about 6 μ high, 9 μ across and separated from each other by 0.8 μ to 3.0 μ . At the apices of the processes, and beneath their surfaces some regular structural features exist that may be mistaken for pores if observed with the phase microscope (Fig. 2D-p). The inter-process area of the shell is wrinkled and may have six to eight minute pores (obvious at 2,000 to 5,000 diameters).

Mature embryos and juveniles can be recognized using the key to

¹ Identifications provided by William A. Weber, University of Colorado Museum, Boulder.

² Support for use of the Stereoscan was provided by Faculty Research Grant D141.

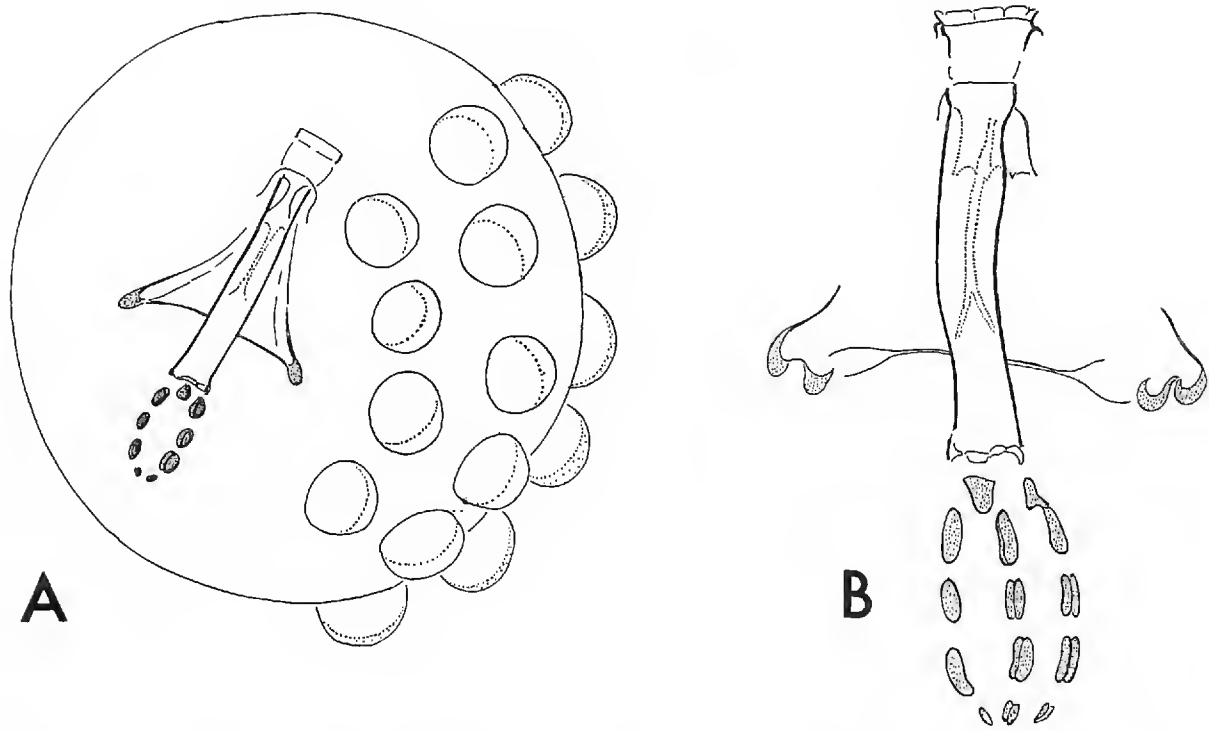


FIG. 1. A. Mouthparts within embryonated egg. B. Mouthparts of adult (specimen 500μ in length).

Macrobiotus in Ramazzotti (1972). However, in larger individuals macroplacoid II is visibly shorter than I or III (Fig. 1B) and these specimens will lead to *M. carsicus* in this key. To arrive at *M. montanus* in this key, the macroplacoids must be considered as being subequal in length and of oval shape, or observation must be limited to the smaller specimens. The cuticles of individuals ranging in size from the smallest (290μ) to the largest (550μ) were examined using the Stereoscan and the specimens were later slide-mounted to confirm their identity from conventional characters. All of the specimens possessed 10 buccal lamellae (Fig. 2E), the cuticle is somewhat wrinkled and while occasional small pores were found, they were not a conspicuous or regular feature. Distinct cribrate structures are present in the intersegmental creases (Fig. 2F-i). In an area dorsolateral to legs III the cribrate structures were observed frequently to be greatly enlarged. For all but the smallest individuals, a distinct granular area is present dorsally at the bases of legs IV (Fig. 2F-e).

Macrobiotus montanus is assigned to the "intermedius group" by Ramazzotti (1972). Present groupings may not reflect phylogenetic relationship because within this group *M. hufelandi* has 10 buccal lamellae as does *M. montanus* but *M. areolatus* has 12. Cuticular pores are characteristic of *M. hufelandi* but are inconspicuous or absent from *M. areolatus* and *M. montanus*. The accumulation of additional infor-

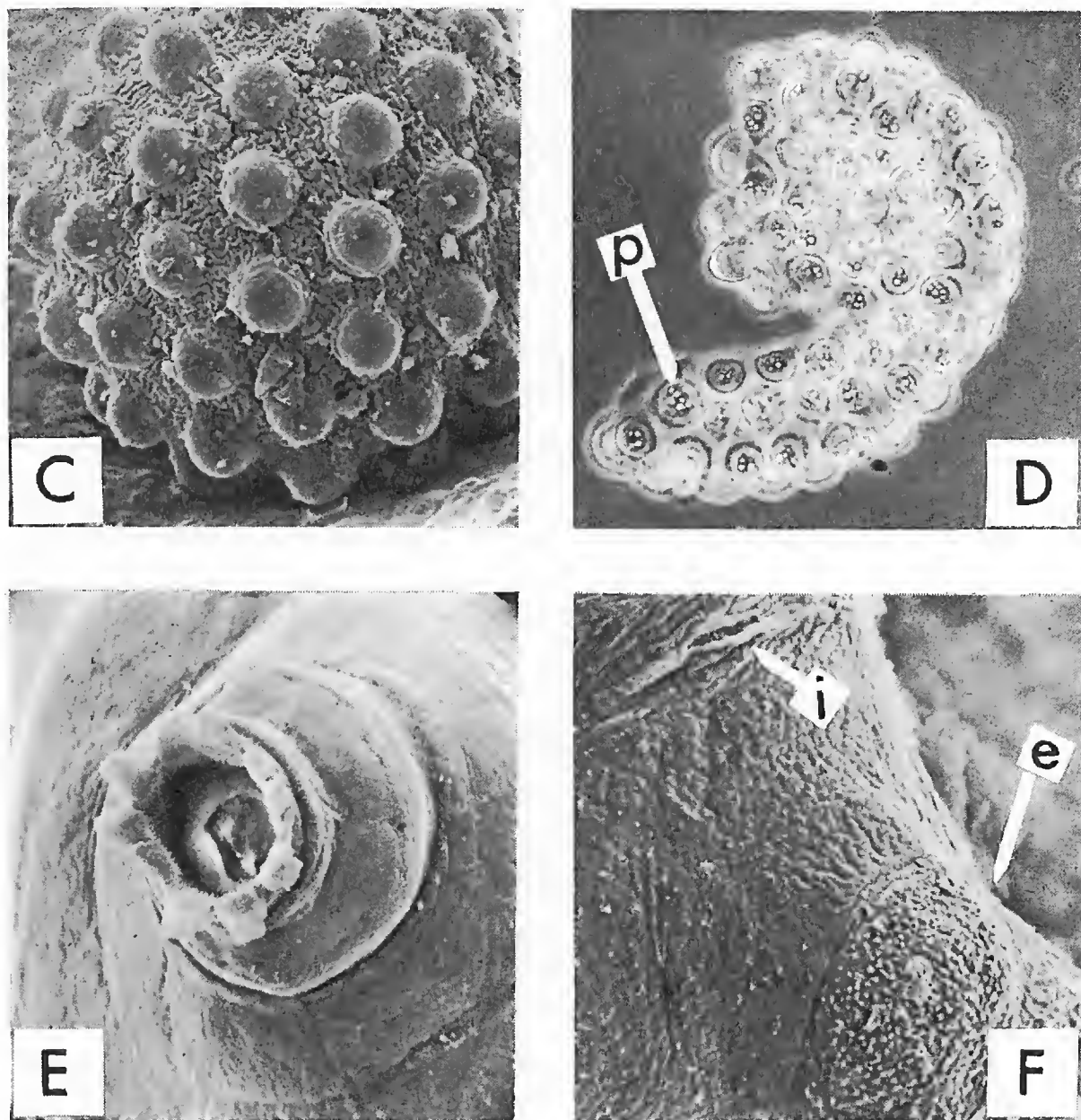


FIG. 2. C. Scanning electron photograph of egg, 600 \times . D. Structure of ruptured egg recorded by phase microscopy, 375 \times . E. Scanning electron photograph of buccal opening, 1,585 \times . F. Scanning electron photograph of cuticular morphology of dorsum, 1,975 \times .

mation resulting from electron microscopy will better define the species of *Macrobotus* and will hopefully provide information by which their relationships can be re-evaluated.

LITERATURE CITED

- MURRAY, J. 1910. Tardigrada. British Antarctic Exped. 1907-9 under command of Sir E. H. Shackelton, C.V.O. Reports on the Scientific Investigations 1 to 5 (83-185 pls. XIV-XXI).
- RAMAZZOTTI, G. 1972. Il Phylum Tardigrada. Mem. Ist. Ital. Idrobiol. Dott Marco de Marchi, Pallanza Italy, 28: 1-732.

New Species of North American Torymidae
(Hymenoptera)

E. E. GRISSELL

University of California, Davis 95616

Material representing four undescribed species of Torymidae has recently been made available through the investigations of several entomologists. I am describing them at present to make the names available for biological studies currently underway.

Two of the undescribed species are in the genus *Monodontomerus* Westwood. No species have been described from North America since Gahan (1941) last characterized and revised the genus. Dr. B. D. Burks (United States National Museum, Washington, D. C.) first sent material and suggested I describe a species of *Monodontomerus* reared from the douglas-fir tussock moth, *Hemerocampa pseudotsugata* McDunnough. Another *Monodontomerus*, reared from an anthidiine bee, *Dianthidium heterulkei* Schwarz, was compared for me with U. S. National Museum material by Dr. Burks and determined as new. Two species of *Torymus* Dalman are also described. One has been reared from a cecidomyiid gall, *Walshomyia cupressi* Gagné, on *Cupressus* and the other from a cynipid gall, *Disholcaspis cinerosa* (Bassett), on *Quercus*.

The holotype, allotype, and some paratypes of each new species will be deposited in the United States National Museum. Paratypes will also be placed in the Canadian National Collection, Ottawa, and the Entomology Museum, University of California, Davis. Additional paratype deposition is indicated where needed.

***Monodontomerus saltuosus* Grissell, new species**

FEMALE HOLOTYPE.—(Chromosome number, $2n = 10$). Body length 4.0 mm, ovipositor 1.4 mm. Head, scape, thorax, coxae, and femora dull metallic blue-green to black (when viewed at some angles), abdomen dark blue-green to almost black, flagellum black, tibiae and tarsi burnt orange, mandibles and wing veins dark brown, wings hyaline except brown stain surrounding stigmal vein and extending from postmarginal vein about one-fourth distance to posterior wing margin. Head, thorax, coxae, femora, and gastral terga IV–VI with fine, even reticulations, mesepimeron, median frenal area, and tergum I polished. Areas with thick, appressed pubescence include: head, dorsum of thorax except frenal area, coxae except median areas, femora, and gastral terga III–V laterally; long erect pubescence present at lateral propodeal margins; eyes with erect, conspicuous pubescence. Face as in Fig. 3; ocellocular distance slightly less than lateral ocellus diameter (5:6); antennal funicle cylindrical, segments subquadrate;

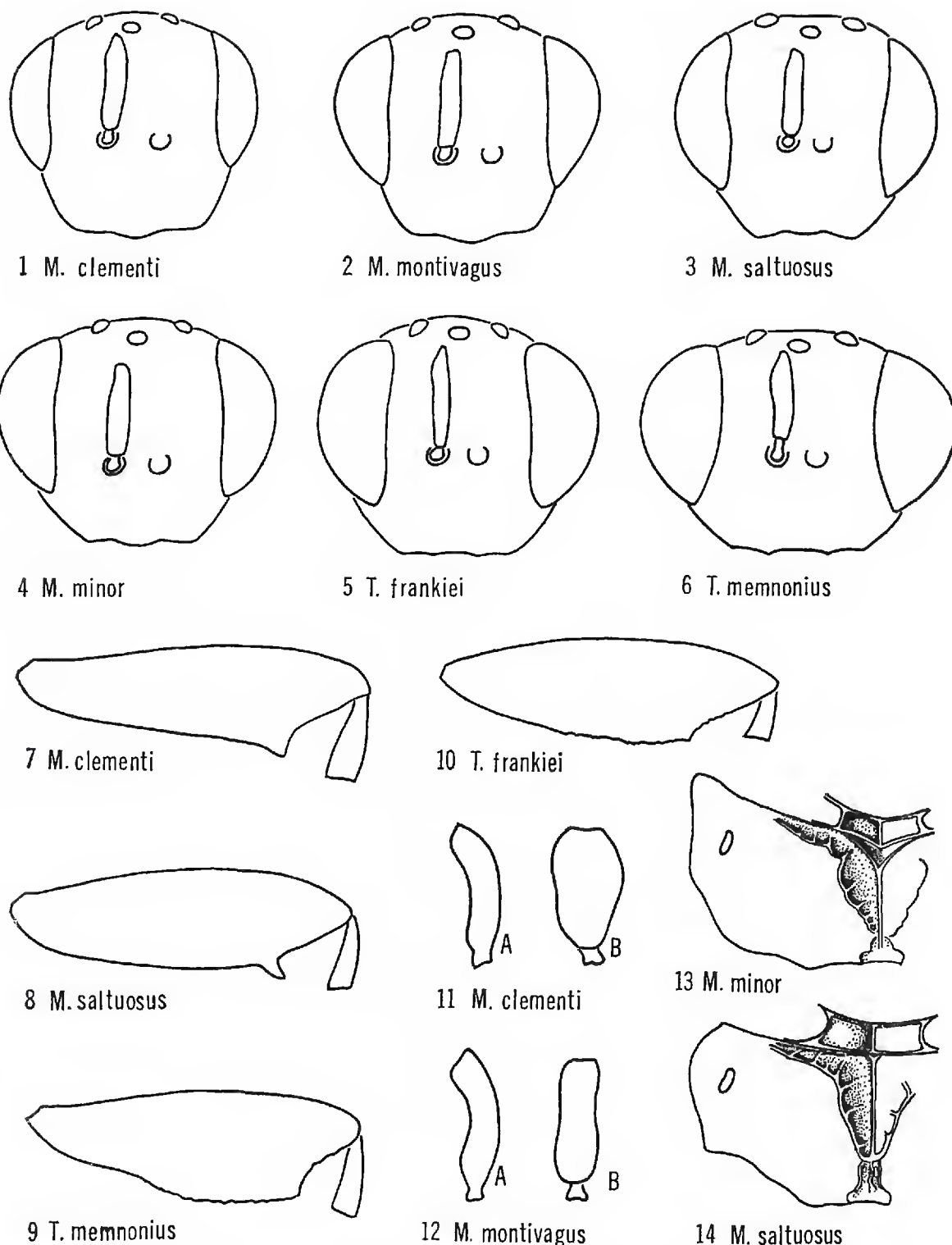
complete malar sulcus present; mandibles tridentate; clypeus slightly protuberant, but not extending to imaginary line connecting lateral corners of oral fossa. Dorsellum of metanotum (Fig. 14) convex with fine, median carina; propodeum with triangular median depression somewhat truncate at posterior fourth, median carina becoming crooked and obscure posteriorly, anteriorly the median carina with obscure fork; forewing with postmarginal vein about one-half as long as marginal; hindfemur with denticle arising abruptly (Fig. 8). Abdomen about as long as head and thorax combined, terga without median posterior emarginations; ovipositor 0.72 times length of abdomen.

MALE ALLOTYPE.—(n = 5). Length 3.2 mm. Similar to female except antennal toruli slightly lower on face.

Holotype female, IRON MOUNTAIN, 24 MILES EAST OF PLACERVILLE, EL DORADO COUNTY, CALIFORNIA, August 1970, ex *Hemerocampa pseudotsugata*, C. G. Thompson collector; allotype, 3 ♀, 3 ♂ paratypes same data; 4 ♀, 4 ♂ same data except coll. 3 November 1971 em. January 1972, D. L. Dahlsten collector. Additional paratypes all same host data and county: 43 ♀, 9 ♂ Plummer Ridge, 22 mi. SE Placerville, coll. 2 November 1971, em. 10 November to 23 January 1972, D. L. Dahlsten collector; 3 ♀, 1 ♂ same data except coll. August 1970. Additional specimens not paratypes: 5 ♀, 1 ♂ Sandia Mtns., near Albuquerque, New Mexico, coll. August and November, 1959, A. Rivas, Yasinski collectors, same host data as holotype. Paratypes will be placed in the collection of the Division of Biological Control, University of California, Albany as well as those institutions listed in the introduction.

VARIATION.—Females vary in length from 2.5 mm (ovipositor 0.69 times as long as abdomen) to 4.2 mm (ovipositor 0.62 times abdomen). Males range in length from 2.1 to 3.2 mm. In several specimens the scape, fore and midfemora are infused with yellow rather than the normal metallic bluish green color. This may have been the result of killing individuals in a teneral condition. In other respects this species appears to be quite constant.

SYSTEMATICS.—*Monodontomerus saltuosus* will most readily run to *M. subobsoletus* Gahan (= *minor* Ratzeburg) in Gahan's 1941 key to *Monodontomerus*. It agrees with *M. minor* in several respects including coloration, sculpturing, facial proportions (except position of antennal toruli), proportion of wing veins, slender hindfemoral tooth, and relative length of ovipositor. *Monodontomerus saltuosus* differs from *M. minor* in both sexes particularly by the convex dorsellum with a weak median carina in *M. saltuosus* (Fig. 14) as opposed to the deeply concave dorsellum with pronounced median carina of *M. minor* (Fig. 13); *M. minor* also has the propodeal carina markedly forked anteriorly and *M. saltuosus* is not noticeably forked. *Monodontomerus*



FIGS. 1-6. Heads of *Monodontomerus* and *Torymus*, facial view. FIGS. 7-10. Hindfemora, lateral view. FIGS. 11-12. Male scape; A. lateral view; B. ventral view. FIGS. 13-14. Propodea, posterior view.

saltuosus may be separated in addition by the posterior apex of the scutellum which is pitted; the apex is smooth in *M. minor*. A character which works well for females but not males, is the relative position of the antennal toruli. In *M. saltuosus* they are somewhat higher than in *M. minor*, causing the lower face to be proportionately longer in *M. saltuosus* (cf. Figs. 3 and 4).

Monodontomerus clementi Grissell, new species

FEMALE HOLOTYPE.—(2n = 12). Body length 3.2 mm, ovipositor 2.6 mm. Head, scape, thorax, coxae, abdomen, and femora except apices, bright metallic blue, flagellum black, tibiae, tarsi, and apices of femora mahogany to burnt orange, mandibles and wing veins dark brown, wings hyaline except slight suggestion of brown stain surrounding stigmal area. Head, dorsum of thorax except frenum, and metapleuron shagreened, mesepisternum and hindcoxa with distinct punctation, femora and propodeum laterally distinctly reticulate, mesepimeron dorsally, frenum, dorsellum, and median propodeum polished, terga I–V polished dorsally but with extremely fine reticulations. Recumbent pubescence on head, dorsum of thorax except frenum, metapleuron, coxae except median areas, femora, terga I and III–VI laterally, longer erect pubescence at lateral margins of propodeum, eyes with inconspicuous erect pubescence. Face as in Fig. 1; ocellular distance greater than lateral ocellus diameter (12:8); antennal funicle cylindrical, segments subquadrate; complete malar sulcus present; mandibles tridentate; clypeus projecting slightly, extending to imaginary line connecting lateral corners of oral fossa. Dorsellum convex with fine median carina which projects slightly posteriorly; propodeum with triangular median depression ending at posterior $\frac{2}{5}$, median carina distinct entire length, anteriorly with an almost imperceptible fork; forewing with postmarginal vein about one-half as long as marginal; hindfemur with tooth arising gradually (Fig. 7). Abdomen slightly longer than head and thorax combined, terga without median posterior emarginations; ovipositor about 1.6 times length of abdomen.

MALE ALLOTYPE.—(n = 6). Length 2.7 mm. Similar to female except scape markedly transversely flattened, distally expanded, and bowed slightly lengthwise (Fig. 11), undersurface appearing polished but with fine reticulations, upper surface strongly shagreened.

Holotype female, 1 MILE WEST WEST THUMB, YELLOWSTONE NATIONAL PARK, WYOMING, emerged 30–31 September 1971 ex cell collected 5 September 1971 of *Dianthidium heterulkei heterulkei*, S. L. Clement collector. Allotype male and 6 female paratypes same data as holotype; 2 ♀, 2 ♂ paratypes same data but coll. 16–24 July 1971, em. 31 July 1971; 16 ♀, 7 ♂ paratypes laboratory reared on *Megachile pacifica* Panzer from original field collected material.

VARIATION.—The primary variation of this species lies in the size of laboratory reared individuals. A size factor of greater than 2 to 1 between largest and smallest specimen resulted from over or undercrowding of the gregarious parasitic larvae on host larvae in gelatin capsules. Field collected individuals (9 females) range in length from 2.4 to 4.5 mm, while their laboratory reared progeny (17 females) range from 2.2 to 5.5 mm. One dwarf specimen has the ovipositor 1.1 times the length of the abdomen. The range for ovipositor lengths of other specimens is 1.5 to 1.8 times the abdominal length. Males range from

2.3 to 3.9 mm. Small specimens tend to have a greater ocellular:lateral ocellus diameter ratio (15:9) than do larger specimens (13:11).

SYSTEMATICS.—*Monodontomerus clementi* will key to *M. montivagus* Ashmead in Gahan's key (1941) and resembles that species in most respects except for the following. In *M. clementi* the body is blue whereas in *M. montivagus* it is olive green, *M. clementi* (Fig. 1) has the malar space equal to one-half the eye height ($\bar{x} = 0.50$, range 0.44–0.58, $n = 20$) as compared to one-third in *M. montivagus* (Fig. 2) ($\bar{x} = 0.32$, range 0.29–0.35, $n = 20$), *M. clementi* has the scape consistently metallic blue whereas *M. montivagus* has the scape yellow, and *M. clementi* has the ovipositor about equal to the body length as compared to *M. montivagus* which has the ovipositor barely longer than the abdomen. An additional character in the males is the scape of *M. montivagus* which is usually more arcuate in lateral view (Fig. 12A) and less expanded in ventral view (Fig. 12B) as compared with *M. clementi* which is more evenly bowed in lateral view (Fig. 11A) and noticeably expanded in ventral view (Fig. 11B).

I take pleasure in naming this species after Stephen L. Clement, a fellow student of the Hymenoptera.

Torymus frankiei Grissell, new species

FEMALE HOLOTYPE.—Length 3.5 mm, ovipositor 3.8 mm. Head, thorax, coxae, femora, and abdomen metallic green, scape and tibiae yellow-orange infused with varying amounts of metallic green, flagellum black, tarsi pale straw-yellow, wing veins brown. Face and frons completely shagreened, thoracic dorsum except frenum transversely rugose with effaced setigerous punctures, frenum medially transversely rugose, laterally longitudinally rugose, propodeum, terga I–II dorsally and inner face of hindcoxa appearing polished to lightly reticulate, outer face of hindcoxa strongly reticulate. Face as in Fig. 5; ocellular distance less than lateral ocellus diameter (8:10); antennal funicle cylindrical, pedicel:F1:F2 ratio as 6.5:7:6.5, F1–5 longer than wide, F6–7 subquadrate; frenal groove distinct, frenum one-third length of scutellum; mesepimeron twice as high as wide; propodeum with two submedian foveae subtended mesally by carinae which connect to posterior of propodeum; hindcoxa dorsally smooth, without setae, with dorsal carina extending onto outer coxal face, hindfemur with angulate denticle subapically beneath (Fig. 10); costal cell anteriorly with almost complete setal row beneath, basal vein with setae, cubital vein bare basally, with several setae at intersection of basal vein, area beneath marginal vein distinctly setose, no obvious setal rows radiating from stigma, stigmal vein subsessile. Terga I–IV obviously incised apically; ovipositor 2.1 times length of abdomen.

MALE ALLOTYPE.—Length 2.3 mm. About as in female except as follows: body coppery green, scape dark, pedicel:F1:F2 ratio as 10:12:10.5, F1–3 slightly longer than wide, F4–7 subquadrate. Punctures on thoracic dorsum obscure, indicated by setae; hindfemoral denticle obscure, appearing almost absent.

Holotype female, 2 MILES EAST FT. BRAGG, MENDOCINO COUNTY, CALIFORNIA, emerged 16 April 1968 ex galls collected 1 March 1968 of *Walshomyia cupressi* on *Cupressus pygmaea* (Lemmon) Sargent, G. W. Frankie collector; allotype, 7♀, and 10♂ paratypes with same data except em. 12 March to 18 April 1968. Additional paratypes: 13♀, 19♂ Ft. Bragg, same data as holotype except coll. 6 March to 25 May 1967, em. 8 April to 14 June 1967. Other specimens not paratypes: 9♀, 5♂ Carson Ridge, Marin Co., Calif., coll. 2–10 April em. 22 April to 7 May, ex *Walshomyia cupressi* on *Cupressus sargentii* Jepson. Paratypes of this species will be placed in the Entomology Museum, Texas A & M University, College Station, as well as those institutions mentioned in the introduction.

VARIATION.—Females of *T. frankiei* range in size from 2.5 mm (ovipositor 2.2 times length of abdomen) to 3.5 mm (ovipositor 2.1 times abdomen). Males vary in length from 1.9 to 2.7 mm. Color ranges from entirely coppery green (some males) to partially green and copper to all green (most specimens). In other respects this species appears quite stable in characters which typically tend to vary in *Torymus* such as relative funicular lengths and ocelli ratios.

SYSTEMATICS.—*Torymus frankiei* clearly belongs to a group of species characterized by *T. fullawayi* (Huber) by reason of its rugose thorax, the frenum differently sculptured than the rest of the scutellum, the large propodeal foveae, and the denticulate hindfemur. It is nearest to *T. denticulatus* (Breland) in lacking the median propodeal carina but differs from that species in having a setose costal cell and the hindcoxa dorsally smooth with the carina extending onto the outer coxal face. In *T. denticulatus* the costal cell is almost bare and the coxa has a completely dorsal carina.

This species is named for Dr. Gordon W. Frankie in recognition of his work with *Torymus*.

***Torymus memnonius* Grissell, new species**

FEMALE HOLOTYPE.—Length 4.4 mm, ovipositor 4.1 mm. Head, coxae, femora, and abdomen black, scape orange, fore and midfemora smoky, hindfemur orange infused with black, tarsi white tinged orange, wing veins brownish white, stigma and parastigma dark brown. Face and frons shagreened, thoracic dorsum, dorsellum, propodeum, hindfemur, and hindcoxa evenly reticulate (size of reticulation varying somewhat with location), abdomen evenly punctate but appearing reticulate except tergum I polished dorsally. Face as in Fig. 6; ocellocular distance equal to lateral ocellus (6:6); antennal funicle cylindrical, pedicel:F1:F2 ratio as 7:10:10, F1–5 longer than broad, F6–7 subquadrate. Frenal groove absent (or seen at lateral margin only), frenum indicated by slightly smaller reticulation than an-

terior of scutellum and by absence of setae; mesepimeron 2.3 times as high as wide, slightly narrowed dorsally; propodeum with large pits one-fifth length of propodeum along anterior margin, two weak submedian carinae one-half length of propodeum on posterior margin, spiracle 1.5 times own long diameter from posterior margin; hindcoxa dorsally weakly carinate and without setae, hindfemur greatly expanded distally and with obvious denticulate angle beneath (Fig. 9); costal cell bare except anteriorly beneath with proximal row one-fifth length of cell and distal row both above and beneath one-third cell length, cubital vein without setae basally, basal vein setose, area beneath marginal vein setose for distal two-thirds, one obscure setal row radiating from stigma distally; stigmal vein sessile. Terga I-IV obviously incised apically, laterally with numerous long recumbent setae; ovipositor 2.0 times length of abdomen.

MALE ALLOTYPE.—Length 3.1 mm. About as in female except body black with bluish tinge, scape and tibiae bluish black. Pedicel:F1:F2 ratio 6:8:8, all segments at least slightly longer than wide. Propodeum with anterior median carina one-half length of propodeum, posterior submedian carina one-third length of propodeum.

Holotype female, H. F. HEEP FARM, 11 MILES SOUTH AUSTIN, TRAVIS COUNTY, TEXAS, emerged 1 July 1971 ex galls collected 21 May 1971 of *Disholcaspis cinerosa* on *Quercus virginiana* Miller, G. W. Frankie collector; allotype, 23 ♀, 20 ♂ same data as holotype except numerous collection and emergence dates. Additional paratypes: 7 ♀, 6 ♂ Texas A & M University, College Station, Brazos Co., Texas, same host data as holotype, various collection and emergence dates. Paratypes of this species will be placed in the Entomology Museum, Texas A & M University as well as those institutions listed in the introduction.

VARIATION.—Size range in females is 3.6 mm (ovipositor 3.0 times length of abdomen) to 4.6 mm (ovipositor 2.7 times abdomen). The ovipositor ranges from 2.0 to 3.0 times as long as the abdomen. Males range from 2.1 to 3.1 mm. In some specimens of both sexes the black body color may be tinged with blue or green. The propodeal carinae of both sexes vary from absent to weakly developed. No specimens have complete carinae.

SYSTEMATICS.—*Torymus memnonius* is very similar to *T. melanocerae* (Ashmead) but differs in having the hindfemur expanded and angulate beneath (slightly bulged in *T. melanocerae* but not angulate), in lacking the frenal groove (distinct in *T. melanocerae*), and in having the body and femora black (*T. melanocerae* is blue to blue-green).

ACKNOWLEDGMENTS

I wish to express my appreciation to Dr. B. D. Burks for the loan of specimens and for suggestions concerning the systematic placement of the 2 new *Monodontomerus*. In addition Dr. D. L. Dahlsten (University

of California, Gill Tract, Albany, California), Dr. G. W. Frankie (Texas A & M University, College Station, Texas), and Mr. S. L. Clement (University of California, Davis, California) have contributed reared specimens for this study. Mr. C. Goodpasture (University of California, Davis) has determined the karotype number of the two *Monodontomerus* in connection with his research. In addition he has offered constructive criticism of this manuscript. I am indebted to these gentlemen.

LITERATURE CITED

- GAHAN, A. B. 1941. A revision of the chalcid-flies of the genus *Monodontomerus* in the United States National Museum. Proc. U. S. Nat. Mus., 90: 461-482.

BOOK REVIEW

ANNUAL REVIEW OF ECOLOGY AND SYSTEMATICS. VOLUME 2. Edited by R. F. Johnston. Annual Reviews Inc., Palo Alto, California. 510 p., 60 figs., 11 tables. 1971. \$10.00.

This volume contains 19 articles by 21 contributors with the majority of articles devoted to aspects of ecology and only three relating to systematics.

For the entomologist with varied interests many articles will have general appeal. Only the article by R. van den Bosch on biological control is devoted exclusively to insects. The article by D. H. Janzen considers the ecological processes of seed predation by insects and other animals with special emphasis on the chemical aspects of host specificity. The colonization of small bodies of water held by leaves, flowers, or tree holes (= phytolermata) by organisms (ranging from bacteria to insects and even a few frog tadpoles), and community structure in this microhabitat are discussed by B. Maguire, Jr. The role of animals including insects in the breakdown of litter receives some attention from M. Witkamp in his article on soils as ecosystem components. The article on laboratory stream research by C. E. Warren and G. E. Davis, although not dealing specifically with insects, presents a valuable discussion of the application of studies in these closed or partly closed systems in relation to natural ecosystems. Feeding strategies are discussed in two articles: the theoretical aspects and models are treated by T. W. Schoener; while D. H. Morse contrasts the adaptive strategies among insectivorous birds.

Two of the three systematic articles deal with phenetics while the third discusses karyotypes. The relationship between character sets in the subject of the article by J. S. Farris. Classificatory strategies and group measures in the cluster concept are discussed by W. T. Williams. The value of the karyotype in systematics is increasing as techniques are developed to detect new ways in which karyotypes differ and this topic is reviewed by R. C. Jackson.

This collection of review articles contains something of value for a wide audience interested in ecology and systematics.—ROBBIN W. THORP, *University of California, Davis, 95616.*

A New *Comadia* from the San Joaquin Valley of California

(Lepidoptera: Cossidae)

R. M. BROWN AND R. P. ALLEN

*Martinez, California 94553 and California Department of Agriculture
Sacramento, 95814*

Barnes and McDunnough (1911) proposed *Comadia* to include four species taken from *Hypopta* (Hubner) and designated *H. bertholdi* (Grote) the type species. Barnes and Benjamin (1923) described six additional species and subsequently described *C. polingi*, the last species to be named (Barnes and Benjamin 1927). *Comadia* has thus stood until the present. Interest in the genus was revived with the discovery of lepidopterous larvae in the roots of Alkali Blite, *Suaeda fruticosa* (L.) Forsk. by the junior author about 1950.

Preliminary study by Harry K. Clench of Carnegie Museum, Pittsburgh, Pennsylvania, indicated this to be a new species, described herein. We thank Mr. Clench for suggesting the name used and releasing his notes, without which this paper would have been more difficult.

***Comadia suaedivora* Brown and Allen, new species**

MALE.—*Head*: Antennae bipectinate to end; longest pectinations three times shaft diameter; shaft white dorsally to end. Palpi upturned close to front, not reaching middle of eye; dark laterally. Front and vertex creamy-white with scattered brown scales. Tongue absent. *Thorax*: Vestiture long, loose, creamy-white, lighter ventrally; collar and posterior edge of thorax dark brown; partagia darker and edged in darker brown. Legs with long hair-like scales; prothoracic coxae and femora with considerable dark brown scaling; mesothoracic and metathoracic legs lighter; metathoracic tibiae and first two segments of tarsi swollen; two pairs of spurs present; tarsi ventrally spined; tarsal segments with brown rings in middle. Forewing dorsally white along costa to subterminal line, white invading upper and distal part of cell; eleven dark brown costal spots; base of cell M_3 - Cu_1 white; caudal edge of median vein to Cu_2 white; both sides of A_2 white; end of discal cell dark brown; basal area of cells M_2 - M_3 and Cu_1 - Cu_2 dark brown; distal of subterminal line fuscous; fringe white with brown checks at end of veins, ochreous patches distad of cell, below origin of Cu_2 and central portion of cell A_1 - A_2 . Forewing ventral, costa with basal three-fifths dark brown, remainder white with costal spots as above; dark subapical patch; subterminal line present, distally dark between veins; remainder of wing light gray, fringed as above. Length of wing, 15 mm. Hindwing dorsally white basad, distad light gray; veins darkened; fringe white. Hindwing ventrally creamy-white with dark brown scales; fringe white. *Abdomen*: Dorsally creamy-white cephalad, caudad darker; extending well beyond hind wings; ventrally creamy-white with evenly scattered brown scales. Length of body 16 mm. Male genitalia with harpe upturned, square at posterior edge,

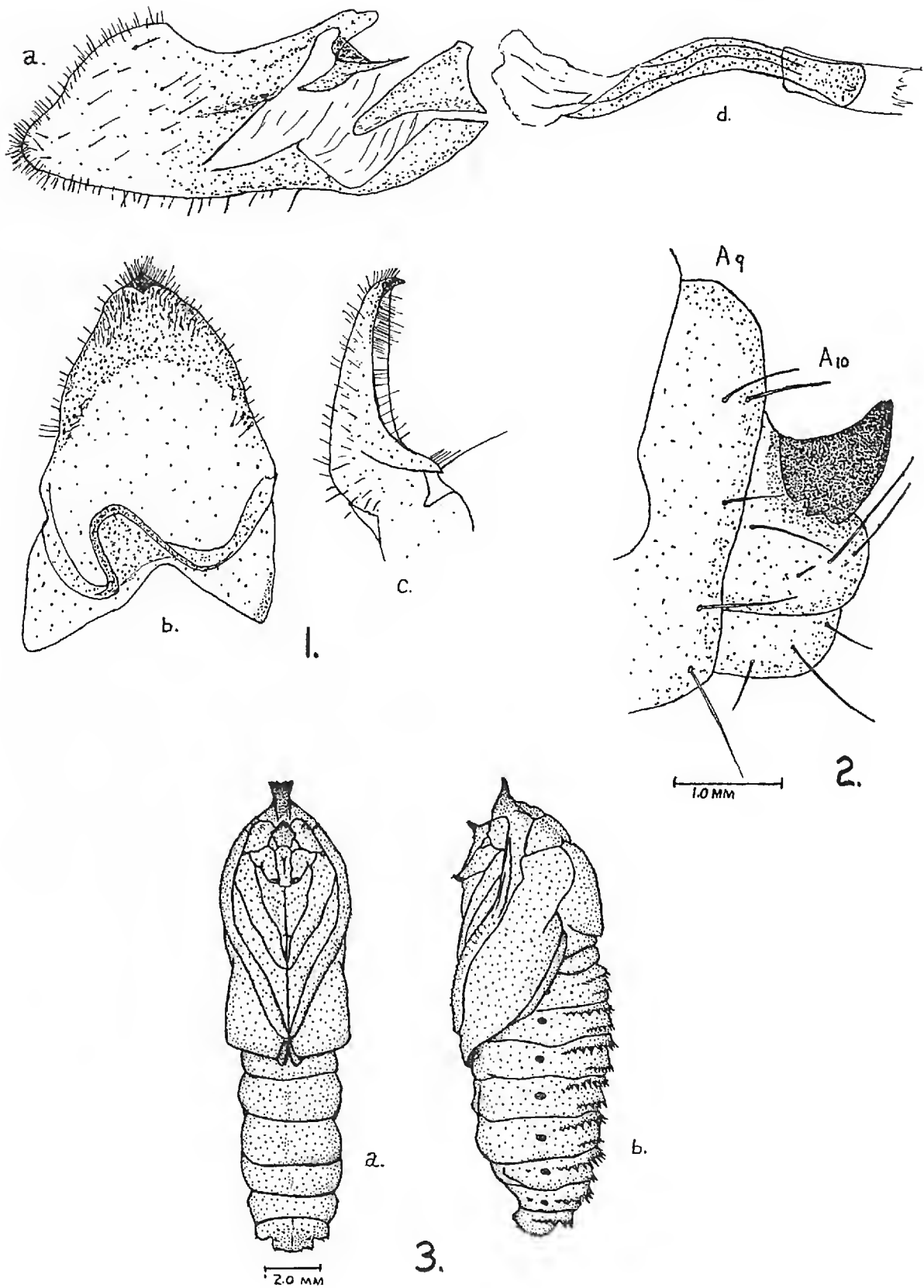


FIG. 1. Male genitalia of *C. suaedivora*, a) left harpe, b) tegumen and uncus (ventral), c) tegumen and uncus (lateral), d) aedeagus, (all 22.5 \times). FIG. 2. Last two larval segments of *C. suaedivora*. FIG. 3. Pupa of *C. suaedivora*, a) ventral, b) lateral.

inner surface lightly excavated; harpe with large hook shaped process at base just below costa (Fig. 1a); transtilla reduced; gnathos spoon shaped just above transtilla; tegumen, broad, hood-shaped, four to six strong setae at inner anterior corners of base; uncus small, turned down in short strong hook (Fig. 1b-c).

FEMALE.—Antennae ventrally serrate; serrations shallowly bifid, each with one seta about as long as free part of projection. Wing pattern similar to that of male, somewhat darker; subterminal line reduced. Abdomen heavier and considerably longer than male. Length of forewing 17 mm.; of body 22 mm.

Holotype male, (California Academy of Sciences, type #11608), TIPTON, TULARE COUNTY, CALIFORNIA, 17 May 1958, R. P. Allen. Allotype, 3 mi. N. Corcoran, Kings County, California, 20 May 1972, R. M. Brown. Paratypes, 80 males, 12 females; California, Fresno Co.: Kerman 1 ♂ 14 May 1962, R. P. Allen; 1 ♂ 9 May 1962, H. E. Gleason; 10 mi. S. Kerman 2 ♂ 3 June 1960, R. P. Allen; Tranquility 1 ♂ 14 May 1962, H. E. Gleason. Kings Co.: 3 mi. N. Corcoran, 3 ♂ 20 May 1972, R. M. Brown. Tulare Co.: Earlimart, 3 ♂ 14 May 1962, 1 ♂ 21 May 1962, 1 ♀ 31 May 1962, D. Rush; Tipton, 1 ♂ 15 May 1953, 1 ♂ 10 May 1956, 15 ♂ 15 May 1956, 33 ♂ 17 May 1958, 4 ♀ 7 May 1956 (reared), 1 ♀ 27 May 1959 (reared), 1 ♂, 1 ♀ 30 May 1959 (reared), 1 ♀ 5 June 1959 (reared), 2 ♂, 1 ♀ 1 May 1960 (reared), 1 ♂ 10 June 1960, 11 ♂ 18 May 1961, 3 ♂, 2 ♀ 21 March 1969 (reared), R. P. Allen.

TYPE DISPOSITION.—The holotype and allotype will be permanently deposited in the collection of the California Academy of Sciences, San Francisco. One pair of paratypes will be deposited in each of the following collections; Carnegie Museum, Pittsburgh, Pennsylvania; Los Angeles County Museum of Natural History, Los Angeles, California; Canada Department of Agriculture, Ottawa, Ontario; American Museum of Natural History, New York, N. Y.; and the collection of the senior author. The remaining paratypes will be placed in the collection of California Department of Agriculture, Sacramento, California.

REMARKS.—Barnes and Benjamin (1923) divided *Comadia* into three groups based on thoracic vestiture as follows: (1) Thoracic scales broad, (*engelhardti* B&B); (2) Thoracic scales hair-like, spatulate at end (see below); (3) Thoracic scales long, narrow to end (*henrici* Grt. & *menfredi* Neum.).

The second group at present is the largest and the most difficult. This group now contains six species and three subspecies: *C. bertholdi bertholdi* Grt., Colorado; *C. bertholdi fusca* B&B, Durango, Colorado; *C. bertholdi edwardi* Neum. & Dyar, Colorado; *C. intrusa* B&B Southern California; *C. dollii* B&B Clark Co. Nevada; *C. stabilis* B&B Trout

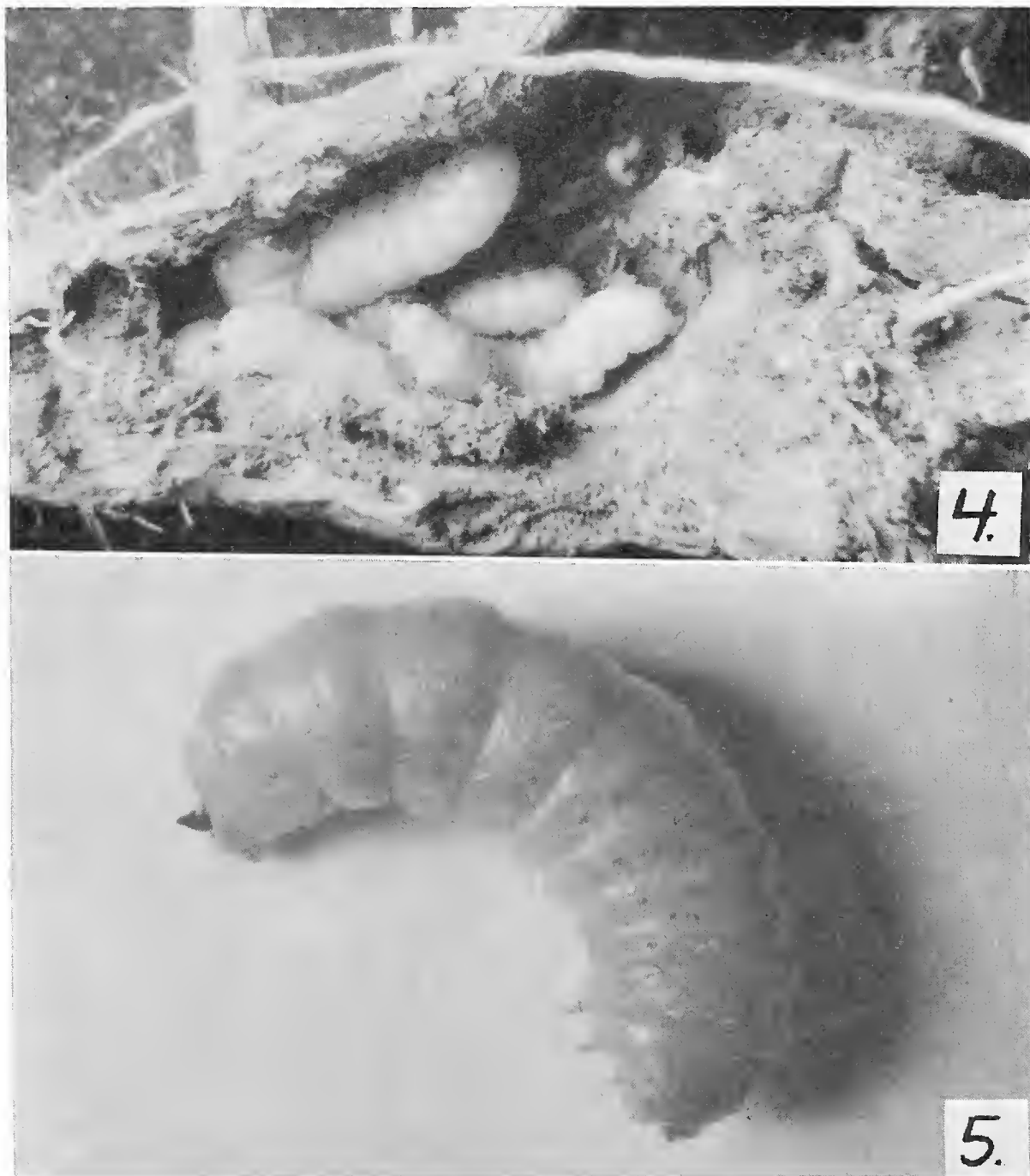


FIG. 4. A cluster of larvae in the hollowed crown of the host, *Suaeda fruticosa*.
 FIG. 5. Mature larvae showing lack of setae and the prominent anal horn.

Creek, Juab Co. Utah; *C. polingi* B&B Bert, Otero Co. New Mexico; *C. suaedivora* Brown & Allen Tipton, California; *C. subterminata* B&B Redington, Arizona.

Comadia suaedivora like the other species, shows considerable variation. The amount of dark shading is the most variable character; only the few white areas described seem to be stable. The majority of females in the type series are smaller than the males. These probably were dwarfed while being reared under artificial conditions. The two females taken at light are the same size or larger than the males.

Comadia suaedivora can be told from *C. dolli*, *C. stabilis*, *C. intrusa* and *C. polingi* by the greater amount of dark suffusion and the whiter costa. The *C. bertholdi* group begins to approach it with *C. b. fusca* being the closest. From this subspecies it can be told by the lack of a prominent dark spot on the forewing below Cu_2 . From *C. subterminata* it can be told by its smaller size and narrower, less rounded forewings, plus the lack of reticulations. This is an arbitrary placement until further study is made.

BIOLOGY

Larvae of *C. suaedivora* bore in the crown and roots of *Suaeda fruticosa* a low, woody halophytic shrub common to the semialkaline soil found in the San Joaquin Valley. Larvae are gregarious and completely hollow the woody area in which they feed (Fig. 5), usually killing the host. They are easily found by digging out and breaking open the crown and roots of the host. Various stages in development of larvae found together in the host indicates a possible two year larval cycle.

The known range of the moth extends from southern Madera County to northern Kern County, including portions of Fresno, Kings, and Tulare counties. A large population at Tipton, Tulare Co. has declined over the years due to host removal by development of cotton storage yards, and perhaps in part by the junior author's intermittent digging of plants in search of larvae. The host does not readily extend itself.

Adults fly from early May to mid June. The males are more attracted to light than females. Rearing by the junior author lends support to this: 15 adults (6 males and 9 females) were reared with a ratio of 40% males to 60% females; in the field 77 specimens were taken (75 males and 2 females) with a ratio of 97.4% males to 2.6% females. If there was an equal attraction for light between the sexes, a more equitable ratio should be found. The most extensive flights have been observed on warm, overcast nights during the latter part of May.

Eggs are deposited in a tight cluster glued to the host, probably near the crown. They have raised surface reticulations forming square and rectangular depressed cells. Eggs are 2.0 mm in height and 1.0 mm in diameter.

Larvae attain a length of 30 mm. When alive they have rose-lavender highlights which fade rapidly when specimens are placed in alcohol. The head is partly covered by the first thoracic segment. Thoracic legs are short, with a strong claw; abdominal legs are represented by crotchets arranged in a uniordinal series on segments A_3 through A_6 .

Setae are sparse and short. The most striking feature of the larvae is the heavily sclerotized horn on the dorsal surface of the anal flap (Fig. 2 & 4). This horn is dark brown and does not extend above the level of the back. The purpose of the horn is open to speculation; it may be pushed against the wood to help the larvae travel inside the host.

Pupae (Fig. 3) are about 15 mm long, dark brown and heavily spined. The spines suggest that the pupa is active and able to travel. Considerable digging in the vicinity of infested plants has produced no pupa in the field, but they have been obtained by rearing. Reared adults leave their pupal cases protruding conspicuously above ground after emergence. This indicates the larvae, upon leaving the host, probably constructs a subterranean cell prior to pupation. Prior to emergence of the imago, the pupa makes its way to the ground surface. Rivers (1897) in a description of the life history of *H. bertholdi* Grt., points out that the pupa also extends above ground prior to adult emergence.

LITERATURE CITED

- BARNES, W. AND J. H. McDUNNOUGH. 1911. Revision of the Cossidae of North America. *Contrib. Natur. Hist. Lepidoptera*, 1: 26-29.
- BARNES, W. AND F. H. BENJAMIN. 1923. Cossidae, Cossinae. *Contrib. Natur. Hist. Lepidoptera*, 5: 88-96.
1927. A new Cossid from New Mexico (Lepid., Cossidae). *Pan-Pac. Entomol.*, 4: 67.
- RIVERS, J. J. 1897. Some Facts In The Life History of *Hypopta Bertholdi* Grote. *Psyche*, 8(249): 10.

BOOK NOTICE

ENVIRONMENT AND MAN. Richard H. Wagner. W. W. Norton and Co., Inc. 491 p., 196 figs., 9 tables. 1971. \$7.50.

This book, produced on recycled paper, is intended as a general introduction to man-environment problems requiring little background in the sciences. The stress is on understanding basic problems. Additional readings are listed at the end of each of the 23 chapters and an Appendix to professional and lay journals containing articles of interest is provided for those who wish to keep up with this rapidly expanding area of information.

The book is divided into phases of reciprocal influence between man and environment: the environment in shaping man; man shaping the environment; the man-made city environment shaping man; and finally the ultimate problem of balancing resources and population to allow coexistence of all organisms. It presents an easy to read, well balanced overview of man-environment problems.—ROBBIN W. THORP, *University of California, Davis, 95616.*

**Notes on the Biology of *Neomachilis halophila*
on a California Sandy Beach**

(Thysanura: Machilidae)

ROBERT BENEDETTI¹

Hopkins Marine Station of Stanford University, Pacific Grove, California

Neomachilis halophila Silvestri, originally described from beaches near San Francisco, is common under rocks and in crevices in the high intertidal zone on California beaches (W. Evans, pers. comm.). I have found it most abundant just on the seaward side of the last terrestrial vegetation in areas covered with rocks too high on the beach to be disturbed by most high tides, and especially among rocks piled in such a manner that a small space occurs between rock and sand. Little is known of the natural history of this species. The present study deals with population structure, activity rhythm, and food. All observations were carried out near Pacific Grove, California, at sites on Pt. Pinos and on Mussel Point near the Hopkins Marine Station in April and May 1972.

POPULATION STRUCTURE.—Specimens (135) were collected at Pt. Pinos 19 and 20 May. In the laboratory they were anesthetized with ether, sexed, and measured under a dissecting microscope. Females were determined by the presence of the elongate ovipositor extending from the eighth and ninth segments (Lubbock, 1873). Length was measured from the tip of the head to the posterior end of the abdomen, excluding caudal cerci and filament (Fig. 1). Males and females occur in approximately equal numbers. Some females are larger than the largest males. A marked discontinuity in size is seen in the population. Many juveniles, no longer than 3.5 mm, are present, but the next shortest size class begins at 8.1 mm. In a Californian lepismid studied by Lasker (1956), seasonal breeding was reported, eggs being found only in April and May. The discontinuity observed in the present study suggests a similarly limited breeding period in late winter or early spring. The numerous juveniles were found along with the much larger adults.

ACTIVITY PATTERN.—Preliminary observations indicated that *Neomachilis* remained at rest during the day, mainly on undersides of rocks. At night they were more active, and were found crawling on sand beneath rocks and on upper surfaces of rocks. Activity patterns of the

¹ Mailing address: 3502 N. 19th, Tacoma, Washington 98406.

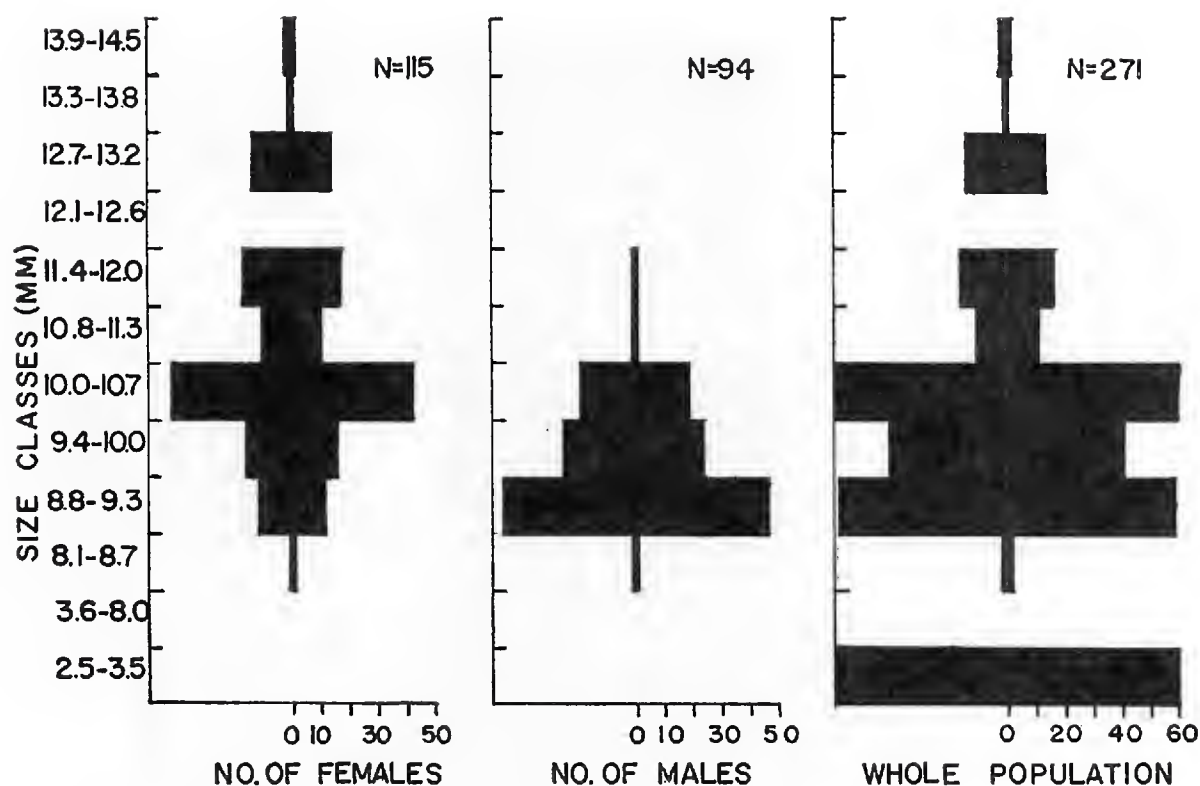


FIG. 1. Population structure of *Neomachilis* at Pacific Grove, California. 19-20 May.

population were determined in two 24-hour periods of regularly repeated field observation, one carried out at Pt. Pinos and the other at Mussel Point. Observations in darkness were made with a red-filtered flashlight. At Pt. Pinos, two areas of about thirty square feet each were marked off and examined every two or three hours for location and number of *Neomachilis*. At Mussel Point one site of approximately thirty square feet was similarly observed. At each observation time animals were categorized as either 1) stationary on undersurfaces of rocks, 2) crawling on sand beneath and around rocks, or 3) crawling on the tops of rocks (Fig. 2). The increase in total number, decrease in number on undersurfaces of rocks, and increase in number on sand and on tops of rocks, all indicate that the activity of *Neomachilis* increases with the coming to darkness, reaches a peak shortly before sunrise, and declines rapidly at dawn (Fig. 2). The early morning activity peak coincides with the period of heaviest dew fall (S. Johnson, pers. comm.).

FOOD AND FEEDING.—Food studies were carried out on animals collected at Pt. Pinos on 25 and 26 May and immediately preserved in 95% alcohol. In the laboratory animals were decapitated and the whole alimentary canal removed as described by Lasker (1956). Intestinal contents were removed, mounted in glycerine, and examined under a

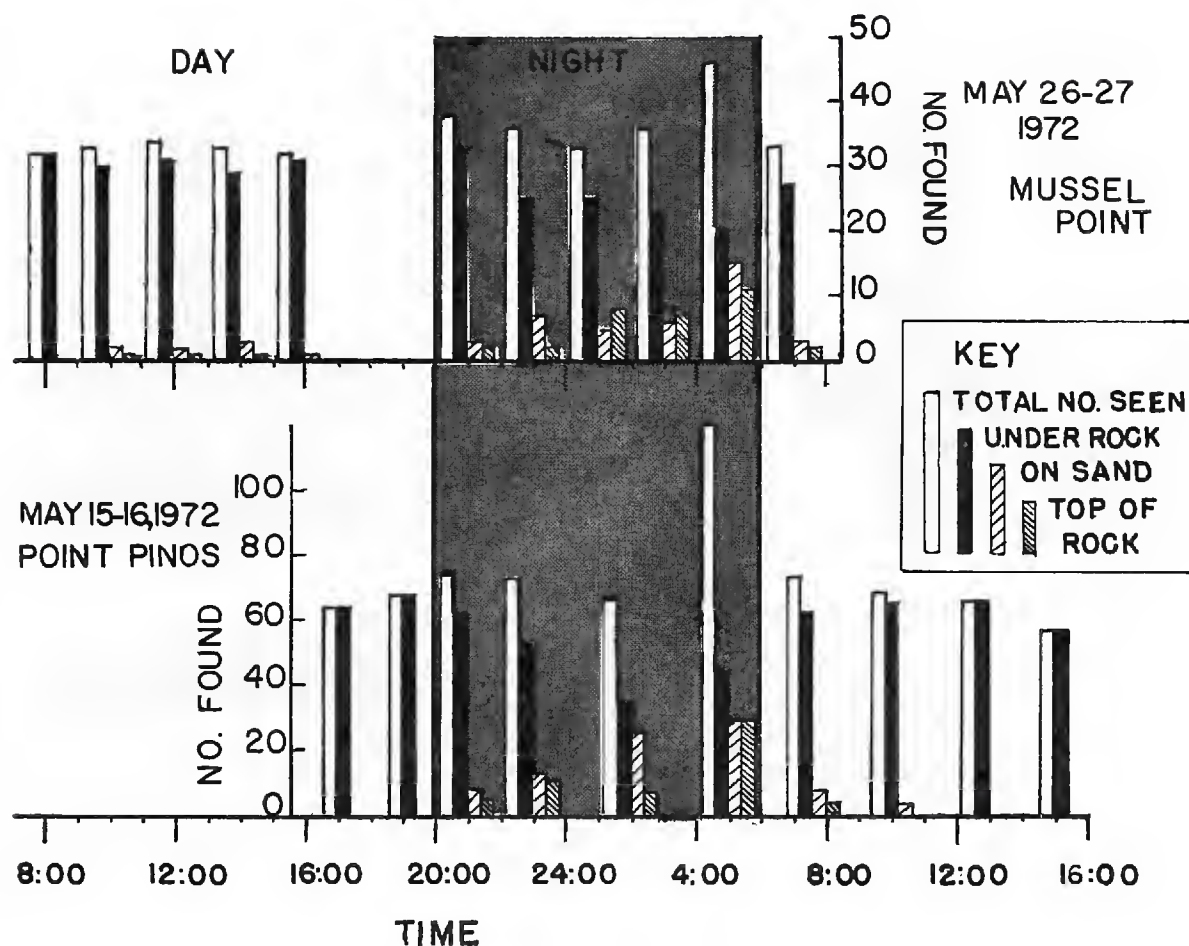


FIG. 2. Activity pattern of *Neomachilis* at Pacific Grove, California.

compound microscope. Major categories of food were determined qualitatively. Six samples of ten animals each were taken over a 16.5 hour period to observe any changes in quantity and nature of the gut contents.

A fair variety of material occurs in the gut of *Neomachilis* with unicellular green algae, yeast, and pine pollen being the materials most often found. The unicellular algae are derived from and encrusting lichen growing on the upper surfaces of the rocks under which *Neomachilis* is found. The probable source of the pollen is the Monterey Pine (*Pinus radiata*), the most abundant tree near Pacific Grove shores, and a species which produces large quantities of wind-borne pollen in late winter and early spring. The source of the yeast is unknown. The other materials found represent common high beach detritus. In 22% of the animals, sporozoans (Gregarinidae) were found in the mid gut, in numbers from two to thirty-six. The largest numbers of animals with guts partly or wholly filled were found in early morning, indicating that feeding tends to occur during periods of greatest activity.

SUMMARY

Neomachilis inhabits the spaces beneath rocks of the upper beach and shore areas just below the land vegetation. Males and females occur in equal numbers, but large females are larger than large males. Activity is largely nocturnal, and greatest activity occurs just before dawn. Common foods include unicellular green algae (from lichens), yeast, pine pollen, and vegetable detritus. Most feeding occurs during the pre-dawn period of greatest activity.

ACKNOWLEDGMENTS

Appreciation is expressed to Dr. Pedro Wygodzinsky for identification, Dr. W. Evans for aid in the preparation of the manuscript, and Drs. Isabella and Donald Abbott for technical guidance during the study.

LITERATURE CITED

- LASKER, R. 1956. The nutrition of the silverfish *Ctenolepsima lineata* with special reference to cellulose digestion. Unpublished Ph.D. thesis, Stanford University, Stanford, California.
- LUBBOCK, J. 1873. Monograph of Collembola and Thysanura. pp. 201-250, The Ray Society, London, pp. 278.

RECENT LITERATURE

THE SURVIVAL EQUATION: MAN, RESOURCES, AND HIS ENVIRONMENT. Edited by Roger Revelle, Ashok Khasla and Maris Vinovskis. 511 p., illus. 1971.

Each of the 38 reprinted articles starts with a brief introduction by the editors. Some of the articles are edited and abridged by the editors, but most retain their tables and references. The volume is copiously illustrated with good quality photos. These are without identifying legends, but a terminal list of credits is provided.

Coniopterygidae from Chile, with Three New Species

(Neuroptera)

PHILLIP A. ADAMS

California State University, Fullerton, 92634

In his excellent revision of the Coniopterygidae, Meinander (1972) lists only one species from Chile. Analysis of material in my collection brings the number of Chilean species to five, three of which are new. The specimens were collected by Luis E. Peña, and remain in my collection unless otherwise noted. P. Wygodzinsky (American Museum of Natural History), has graciously allowed me to borrow the type of *Pampoconis latipennis*.

The genitalic terminology of Meinander (1972) is followed, using these abbreviations: ect—ectoproct, gs—gonarcus, p—penis, pm—paramere, st—stylus.

PAMPOCONIS LATIPENNIS Meinander

(Fig. 2f)

Aisen, Puerto Ibañez, 12–17 January 1961. Genitalia of this specimen closely resemble those of the type. The ectoproct margins are smoothly curved in both specimens, not angulate as in Meinander's Figure 90A; his outline apparently follows the protruding setose subanal plate and the medial surface of the stylus, rather than the inconspicuous ectoproct margin. The posterior penis plates are fused ventrally almost to the apex; on the Aisen specimen, a ligulate membranous lobe protrudes posteriorly to the ninth sternite and a dark oval sclerite lies between the antennal bases. Previously recorded from El Bolsón, Rio Negro [Neuquén], Argentina, approximately 400 miles north (holotype ♂, examined).

***Pampoconis punctipennis* Adams, new species**

(Fig. 1)

MALE.—Head with unsclerotized area including antennal sockets, extending in long tongue to clypeus; narrow median dark y-shaped band from vertex supports antennal articulations. Eye small. Antennae 3.3 mm long, 36 segments about 1.5 times longer than wide, densely pale pilose. Apical labial palpomere spatulate. Body sclerites dark fuscous, legs paler. Wings (Fig. 1e). Membrane pale; in forewing, distal veins and wing margin dark-spotted. Forewing length 5.6 mm. Male genitalia with ectoprocts (Fig. 1a–b) bearing 5–6 stout marginal spines (modified setae). Ninth sternite with lateral tufts of long setae, and posterior ligulate sclerite. Penis a pair of sclerites, rodlike anteriorly, vertically flattened

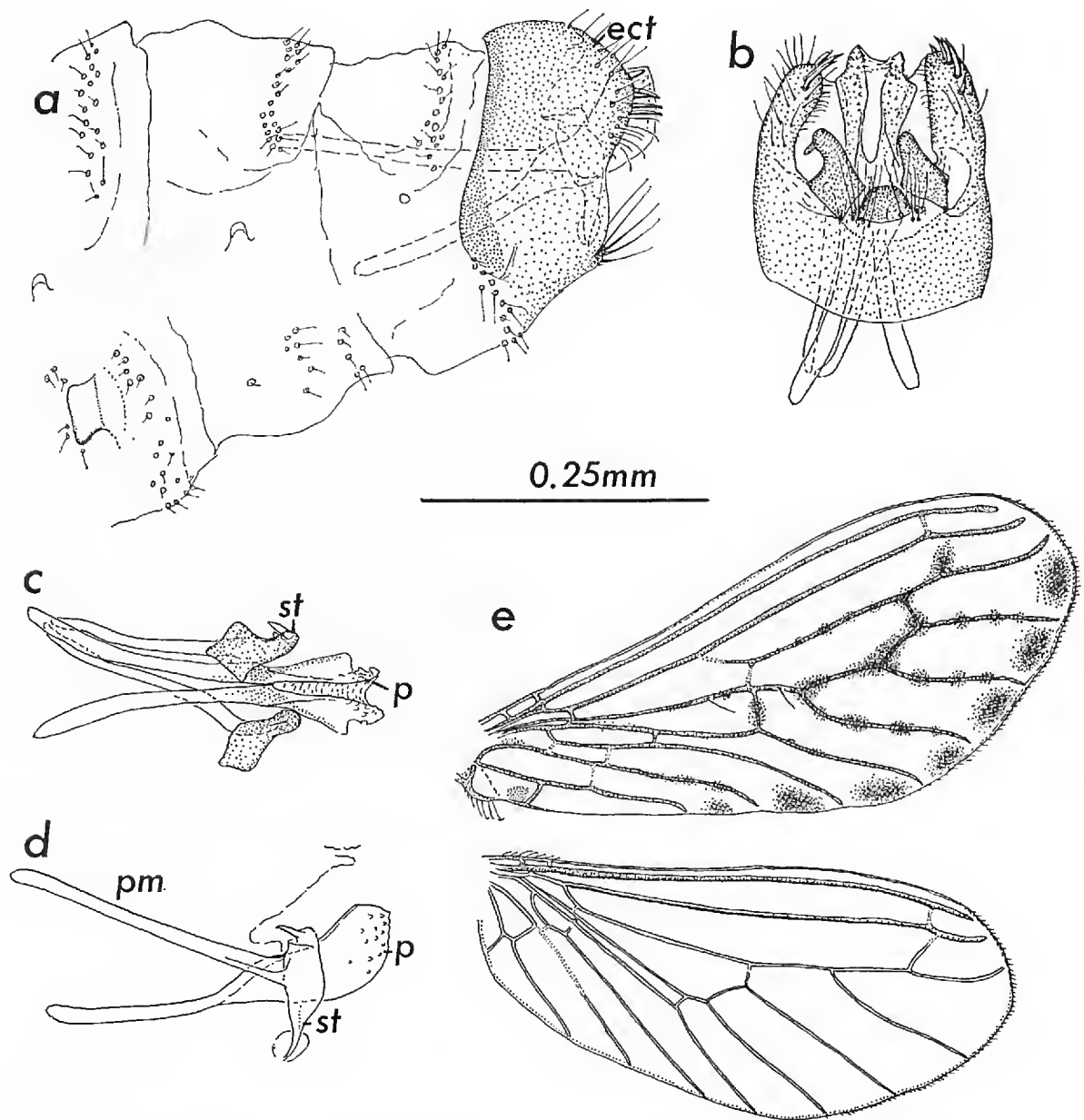


FIG. 1. *Pampoconis punctipennis*, male: a, b, terminalia, lateral and ventral; c, d, penis and styli, ventral and lateral; e, wings. Scale for a-d.

and spinose posteriorly. Styli articulate on ectoproct, bearing dorsal knob with anteriorly directed spine, parameres long and rodlike.

Holotype male, SANTIAGO, RIO COLORADO, CHILE, October 1958 (California Academy of Sciences, San Francisco, in alcohol).

This species differs from the other two *Pampoconis* species in wing maculation, in presence of sclerite posteriorly to the ninth sternite, and in shape of the styli.

***Pampoconis uncinatus* Adams, new species**

(Fig. 2a-e)

MALE.—Head with large unsclerotized area, lacking median sclerotized band of *P. punctipennis*. Eye height 0.33 mm. Antennae 2.5 mm, 26 segmented. Seg-

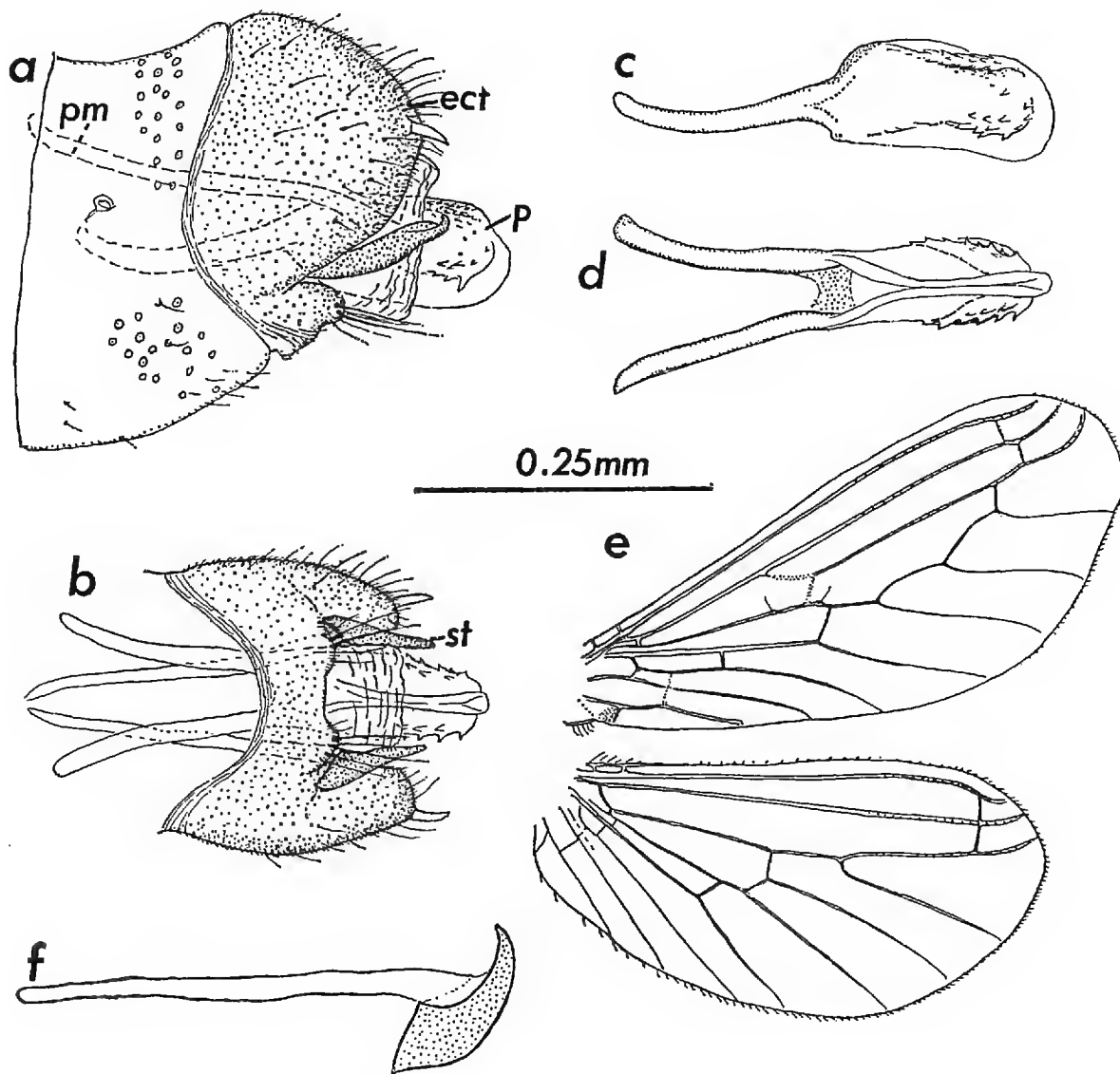


FIG. 2a-e, *Pamponis uncinatus*, male: a, b, terminalia, lateral and ventral, c, d, penis, lateral and ventral; e, wings. FIG. 2f, *Pamponis latipennis*, stylus, lateral. Scale for a-d, f.

ments about 1.5 times as long as wide, sparsely pale pilose. Body sclerites brown, scuta with darker spot each side, first and second axillary sclerites black. Abdomen weakly sclerotized except for terminalia; underlying tissue pink. Wing veins uniformly brown, membrane paler. Forewing length, 4.65 mm. In forewing, R_{s1} curves sharply anteriorly, CuP not sinuous. Genitalia with ectoproct (Fig. 2a) bearing single posterior marginal spinose seta; a tuft of setae on lateral apices of ninth sternite. Styli (Fig. 2b) articulating ventrally on ectoproct, with apical hook extending about one third of stylus length; parameres rodlike. Penis (Fig. 2c, d) 0.364 mm long, with anterior rods; a pair of posterior vertical spiny plates bear serrate-margined lateral ridges and broad dorsolateral expansions.

FEMALE.—As for male except: Antennae 1.85 mm, 27 segmented; eye height 0.22 mm; terminal maxillary palpomere slightly swollen. More robust, with shorter legs. Forewing length 4.34 mm. Genitalia resemble those of *P. latipennis*.

Holotype male, and allotype, TALCA, EL RADAL, CHILE, 900 m, 28-30 November 1957 (California Academy of Sciences, in alcohol).

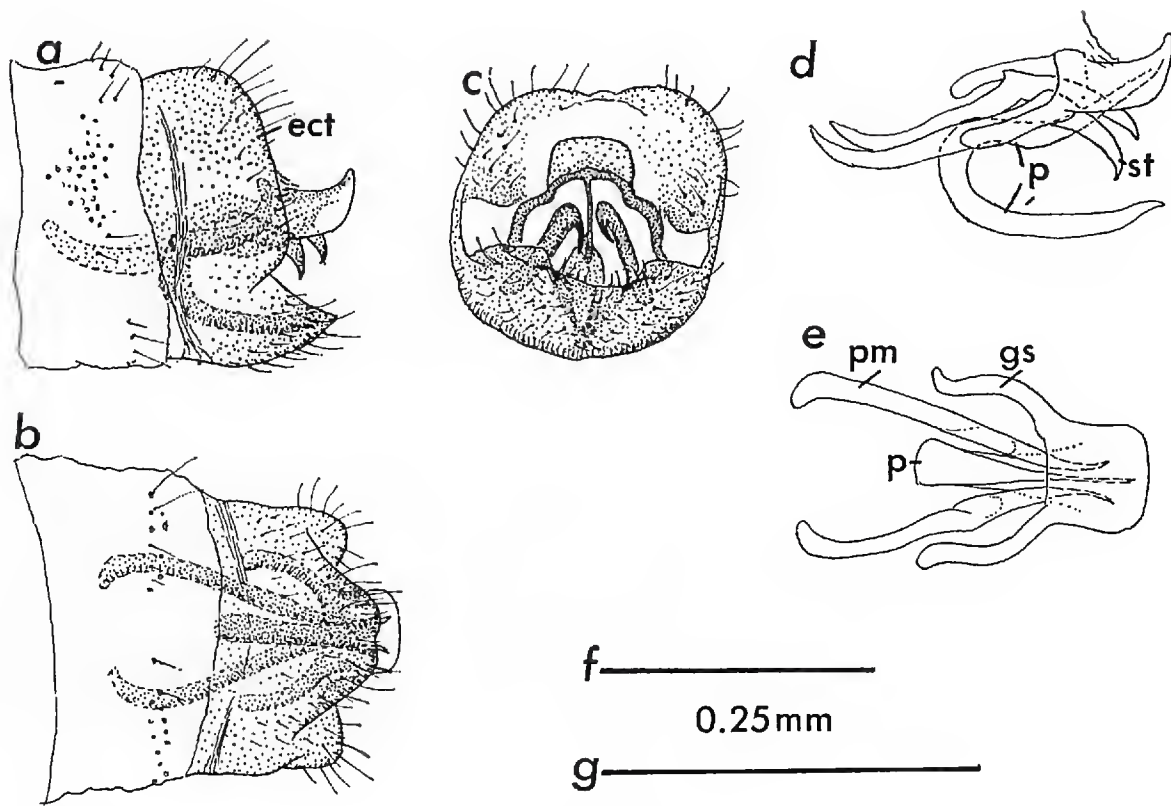


FIG. 3. *Incasemidalis meinanderi*, male: a, b, c, terminalia, lateral, ventral, and apical; d, e, internal armature, lateral and dorsal, f, scale for a-c; g, scale for d, e.

This species is similar to *P. latipennis* Meinander, but differs in having a pronounced forward curve in end of Rs_1 , non-sinuuous CuP, in location of the ectoproct spine, in shape of stylus (which is a larger, sickle-shaped simple hook in *P. latipennis* Fig. 2f) and in structure of penial apex. The genitalia are less massive than in a male *P. latipennis*, which had a 0.465 mm penis and a 4.08 mm forewing.

***Incasemidalis meinanderi* Adams, new species**

(Fig. 3)

MALE.—Head gray-brown, similar in shape to that of *I. peruviansis* Meinander but eyes are relatively larger (height of eye, 0.28 mm; bottom of eye to top of postocular lobe, 0.43 mm). Antennae 39–40 segmented, 2.8 mm long, resembling those of *I. peruviansis*. Body sclerites dark brown; abdomen pale except for terminalia. Wings with membrane light brown, paler posteriorly. Venation much as in *I. peruviansis*, but in both wings radial crossvein intersects $Rs+MA$ at its fork. Forewing length 4.02 mm, width 1.57 mm; hindwing length 3.29 mm, width 1.50 mm. Male genitalia with ectoprocts ventrally rounded and bent inward; ninth sternite strongly sclerotized and bifid apically. Gonarcus bears arched nearly rectangular median projection. Parameres thin downcurved hooks attached to anterior rods. Penis dorsally forms thin vertical blade attached to ventral side of gonarcus projection; ventrally widening into curved band attached to apex of ninth sternite. Tenth sternite not apparent.

Holotype male, COQUIMBO, EL CALABOZO, ILLAPEL, CHILE, 1700 m, 21–23 November 1959 (California Academy of Sciences).

This specimen conforms to the generic description by Meinander in all respects except that no tenth sternite is present. It differs from both *I. colombiensis* and *I. peruviansis* in the shape of the gonarcus lobe, and in the simple bandlike penis. I take pleasure in naming the species after Martin Meinander, the eminent specialist in Coniopterygidae.

SEMIDALIS KOLBEI Enderlein

This species is abundantly represented from 23 localities extending from Coquimbo (Ñague, Los Vilos) in the north to Magellanes (Natales) in the south, and from the coast to the Andes. Dates range from September through March. Two female specimens represent the first record from Argentina (Neuquén, San Martín de los Andes, 11 March 1955, F. W. Walz).

LITERATURE CITED

- ENDERLEIN, G. 1906. Monographie der Coniopterygiden. Zool. Jahrb. Abt. Syst. Oekol. Geogr. Tiere, 23: 173–242.
- MEINANDER, M. 1972. A revision of the family Coniopterygidae. Acta Zool. Fenn. 136: 1–357.

A New Species of *Hamotus* from Galleries of *Microcerotermes septentrionalis* in Western Mexico¹

(Coleoptera: Pselaphidae)
(Isoptera: Termitidae)

DONALD S. CHANDLER AND WILLIAM L. NUTTING

University of Arizona Tucson, 85721

The proposed species can be placed by Park's (1942) monograph in the subgenus *Hamotoides*, Group XIV, where it keys out to *Hamotus* (*Hamotoides*) *veracruzensis* Park. This new species is easily separated from *H. veracruzensis* and all others in the group by the concave tergite V of both sexes.

***Hamotus* (*Hamotoides*) *cavus* Chandler and Nutting New Species**

Stramineous to castaneous, stramineous pubescence composed of a moderate number of long setae. Head subtruncate at base; eyes prominent, containing approximately 37 facets; posterior emargination of eye densely pubescent, projecting across one-third eye width; two small vertexal foveae between eyes, large, oval median fovea between antennal tubercles; single median gular fovea; mandibles four-toothed; third segment of maxillary palpi with moderate groove through entire length; antennae with distinct, three segmented club.

Pronotum only slightly inflated anterior to foveae, its anterior edge truncate; median fovea not much wider than transverse sulcus connecting median and lateral foveae, transverse sulcus deep with distinct edges, lateral foveae large.

Elytron widened apically, rounded and notched at lateral apical edge and with two basal foveae; sternites and tergites gradually narrowing apically, sternites I-IV with lateral foveae, sternite V without, tergites I-IV margined laterally, I-III with two close lateral foveae on each side, IV-V with one lateral fovea on each side, tergite V concave.

Males with small spine on inner side of protibiae (fig. 1), spine difficult to see through dense pubescence.

HOLOTYPE MALE.—length 2.40 mm; head length 0.53 mm, width across eyes 0.51 mm, width across antennal insertions 0.25 mm, 0.29 mm from head base to median antennal fovea, vertexal foveae 0.08 mm from eyes, median antennal fovea 0.12 mm from vertexal foveae; antennal segment lengths and widths: I 0.17 × 0.09 mm; II 0.08 × 0.08; III 0.07 × 0.07; IV 0.07 × 0.07; V 0.06 × 0.08; VI 0.07 × 0.08; VII 0.05 × 0.08; VIII 0.05 × 0.08; IX 0.10 × 0.12; X 0.17 × 0.16; XI 0.24 × 0.19; third segment of maxillary palpi 0.31 mm long, 0.12 wide.

Pronotum length 0.48 mm, 0.24 mm wide at base, 0.52 mm wide across lateral foveae; median and lateral foveae 0.11 mm from base, lateral foveae 0.21 mm from median fovea.

Elytron 0.77 mm long, 0.56 mm wide near apex; fovea 0.06 mm apart on elytron; widths between lateral foveae of tergites: I 0.53 mm; II 0.65; III 0.59; IV 0.53;

¹ University of Arizona Agricultural Experiment Station Journal Series #2061.

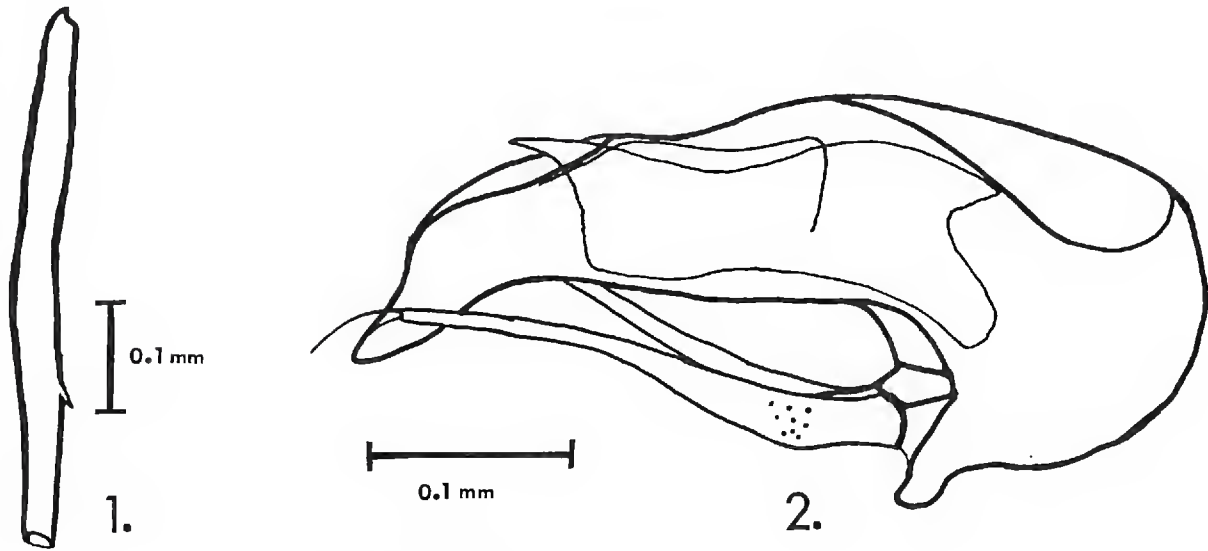


FIG. 1. Anterior view male protibia.

FIG. 2. Left lateral view male genitalia.

V 0.34; tergite V in form of rounded, thick rhomboid, 0.24 mm long; sternite widths between lateral foveae: I 0.73 mm; II 0.89; III 0.76; IV 0.57; sternite V 0.39 mm wide.

Protibia 0.51 mm long, spine 0.37 mm from base. Male genitalia asymmetrical (fig. 2).

FEMALE.—Similar to male but lacking spine on protibiae.

Holotype male, 3 MI N BARRA DE NAVIDAD, BAHIA DE COASTECOMATE, JALISCO, MEXICO, 9 August 1964, in galleries of *Microcerotermes septentrionalis*, W. L. Light and G. C. Nutting.

PARATYPES.—4 males, 15 females, same data as holotype. Slide mounted holotype male to be deposited at the Field Museum of Natural History, Chicago.

At least 40 of these beetles were observed when the extensive superficial galleries of *Microcerotermes septentrionalis* Light were broken into. The colony, probably numbering in the tens of thousands, occupied several feet of a sound log, about 1 foot in diameter and 12 feet long, in a dense thorn forest area. About two dozen pairs of *Nasutitermes nigriceps* (Haldeman) (*Termitidae*) were also established in cells within abandoned peripheral workings of the *Microcerotermes* colony. These incipient colonies consisted of pairs with no brood and some with a small number of eggs, nymphs and soldiers. Further, one incipient colony of *Incisitermes platycephalus* (Light) (*Kalotermitidae*) was found in the same situation.

Park (p. 310) mentions that other *Hamotus* species have been collected with termites. Little can be said about any kind of relationship between the new species and any of the termites beyond the fact that

they were in the galleries with *Microcerotermes*. In such a rich association the possibility of their acting as predators seems especially good.

LITERATURE CITED

- PARK, O. 1942. A study in neotropical Pselaphidae. Northwestern Univ. Studies Bio. Sci. Medicine, No. 1, 403 p.

SCIENTIFIC NOTE

Lectotype designation for *Gerris buenoi* Kirkaldy (Heteroptera: Gerriidae).—Recently we wanted to examine the type material of *Gerris buenoi* Kirkaldy (1911, Entomol. News, 22: 246) in connection with our work on the aquatic Hemiptera of California. Kirkaldy's description was published posthumously through the efforts of J. de la Torre-Bueno. The description is incomplete to the extent that the number of specimens examined, their locality data, and deposition are not given. Kirkaldy apparently had both macropterous and apterous males and females. Torre-Bueno, in his note appended to Kirkaldy's description, states that E. P. Van Duzee supplied the material on which the description was based, and that the bugs bore a manuscript label "*Gerris sulcatus* Uhler." Furthermore, Torre-Bueno said that the "species is widely distributed and ranges from British Columbia to the Atlantic states."

Drake and Harris (1934, Ann. Carnegie Mus., 23: 179-240) apparently did not see type material of *buenoi* when they published their revision of the North American species, although they stated that the "type is in the Kirkaldy collection, U. S. National Museum." A search of this collection did not reveal its presence, and there is no record of the "type" ever having been deposited there.

Paul Arnaud, of the California Academy of Sciences, San Francisco, has located in the Academy collection at least a portion of the material that was before Kirkaldy. It consists of three macropterous females all bearing E. P. Van Duzee collection labels. One specimen has a handwritten label "*Limnotrechus sulcatus* Uhl." plus the following locality data: Ft. Collins, Colorado, July 12, 1898, E. P. Van Duzee collector. We are selecting this specimen as lectotype of *Gerris buenoi* Kirkaldy. The data on the other two females are "N. Colo., May 10, 1898" and "Montreal West, May 4, 1903." The lectotype agrees with the usual interpretation of *buenoi*.—A. S. MENKE, *Systematic Entomology Laboratory, U.S.D.A., Washington, D. C. 20560* AND J. T. POLHEMUS, *University of Colorado Museum, Boulder*.

**Descriptive Morphology of Eggs of Some Species
in the *Macrobotus hufelandii* Group**

(Tardigrada: Macrobiotidae)

ALBERT A. GRIGARICK, ROBERT O. SCHUSTER
AND ELIZABETH C. TOFTNER

Department of Entomology, University of California, Davis, 95616

The identification of species of *Macrobotus* is frequently dependent more on characteristics of the egg than on features of the adults. The existing descriptive morphology of these eggs has resulted mainly from observations by light microscopy before the development of phase contrast and with scant attention being paid to details now recognized as important for species discrimination. Light microscopes can provide usable images only to 1,000 \times and can't resolve small but useful details. Phase systems provide additional information but still can't detect minute detail, distinguish between surface and subsurface features, or provide much information concerning surface topography. Vague and inconsistent terminology used to communicate information has lessened the value of light microscope observations. Illustrations are often of poor quality and written descriptions are usually incomplete and are not always compatible with the drawings.

The scanning electron microscope (SEM) provides capabilities for observing new information about these eggs and for photographically recording this information in a manner that can be communicated precisely. In addition, information so recorded can be easily quantified and analyzed by existing systems. We have developed a simple method for recording and analyzing information in a reproducible and communicable form and have attempted to identify this information with species of *Macrobotus* in the *hufelandii* group.

PROCEDURE

To be able to study eggs of reasonably consistent quality, a standardized procedure was used for the preparation of all samples. The eggs, in small quantities of water, were fixed with boiling 95% ethanol and later dehydrated in absolute isopropanol. The isopropanol was replaced by amyl acetate and the specimens critical-point dried (Anderson, 1951) using CO₂ at 69 K cm². Silver conductive paint was used to affix the eggs to SEM stubs and the specimens were vacuum coated with 100 Å of silver followed by 100 Å of gold.

Each egg was photographed using a Cambridge Stereoscan Mark II microscope. The photographs were taken at approximately 1,000 diameters and these images were used to determine egg diameter, the number of processes per hemisphere, the lengths and widths of processes and the amount of serration of the apical discs.

A Metals Research Instrument Corporation "Quantimet 720" Image Analyzing Computer (IAC) was used to detect and record features of the photographic enlargements of the egg shells. High contrast 3,000 diameter enlargements of each egg were examined using a 25 mm lens on the video scanner and the information was displayed as a format of 300×300 picture points (PP), with each PP representing a length of 0.13 mm of the $3,000\times$ photograph. Expressed as micra, an area of $13\mu \times 13\mu$ (169 square micra) of egg surface was analyzed, and each PP represented a length of 0.043μ or an area of 0.0018 sq. micra.

The following characteristics of each egg were recorded with the IAC: 1) total pore area; 2) total number of pores; 3) pore size distribution expressed as the number of pores with diameters greater than 0.258μ , 0.344μ , 0.430μ , 0.516μ , 0.602μ , 0.688μ , and 0.774μ ; 4) total perimeter of pores.

The *hufelandii* group of *Macrobiotus*, further limited to those for which the pharynx contains two macroplacoids but no microplacoid, contains the following species: *hufelandii* Schultze, *hufelandii recens* Cuénot, *pseudohufelandii* Iharos, *hibiscus* Barros, *anderssoni* Richters, and *inermis* Binda and Pilato. Fifty eggs of this group from worldwide localities were examined. The literature was surveyed for descriptive information and drawings of the eggs of these species. Our photographs of eggs best agreeing with published information were assumed to represent those species. New information provided by this study is presented 1) as photographs, and 2) as detailed description provided by SEM and IAC study.

Many of the eggs could not be assigned to described species because they differed from presently accepted parameters of size, number of processes, or sculpture of the shell. The application of numerical taxonomy programs to accurate measurements of multiple characters will eventually be used to delimit species and populations. The potential of a combined SEM-IAC approach to secure information suitable for statistical studies has been demonstrated by applying 2-way analysis of variance and a mean separation by Duncan's multiple range test for the small samples now available. For three species with multiple specimens the analysis of variance used only four replications of selected characters for the entire egg and three replications for characters of

TABLE 1. Mean values for measurements of eggs of *Macrobiotus* based on SEM and IAC data. Mean values of characters of different species associated with the same letter are not significantly different from each other at the ** 1%, or * 5% levels according to Duncan's multiple range test.

	nr. hibiscus n = 2	hibiscus n = 6	andersoni n = 4	hufelandii n = 8	? hufelandii n = 1	hufelandii recens n = 1
ENTIRE EGG						
Egg diameter in μ^{**}	70	58b	81a	73ab	82	53
Number of processes/ hemisphere**	143	117c	34a	81b	62	89
Process diameter in μ^{**}	5	4b	10a	6b	8	5
Process length in μ^{**}	6	5b	16a	7b	10	7
Discal serrations	9	9	10	16	4	10
Disc open or closed apically	closed	closed	closed	closed	open	closed
169 SQ. MICRA OF EGG SURFACE						
Number of pores**	41	142b	76ab	26a	0	168
Pore area in sq. μ^*	19	33b	36b	13a	0	25
Pore perimeter in μ^{**}	59	148b	109b	35a	0	121
Pore diameter distribution						
>0.258 μ	40	146	71	24	0	137
>0.344 μ	40	103	66	22	0	107
>0.430 μ	38	81	60	22	0	62
>0.516 μ	32	66	55	19	0	36
>0.602 μ	25	52	46	15	0	16
>0.688 μ	18	40	34	12	0	11
>0.774 μ	14	28	30	9	0	7

the egg surface although the numbers of individuals indicated in table 1 are greater.

DISCUSSION

Macrobiotus hufelandii Schultze, 1833 (table 1, fig. 3)—the original description of *hufelandii* didn't include the egg stage. Doyère (1840) first described it as spherical and studded with processes swollen at the top but didn't mention whether the shell had pores. Most

authors presently agree that the egg of *hufelandii* has a smooth shell with a circle of pores around the base of each process.

Eight eggs agreeing with this description were available from collections made in Sweden. These eggs are most distinguished by the reduced number of pores. The smallest pore area was 2 sq. μ per 13 μ sq. with pore diameters in the range of 0.43 μ or less.

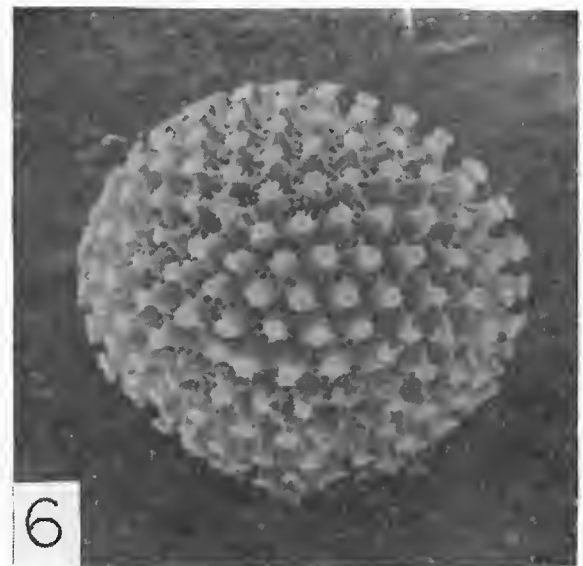
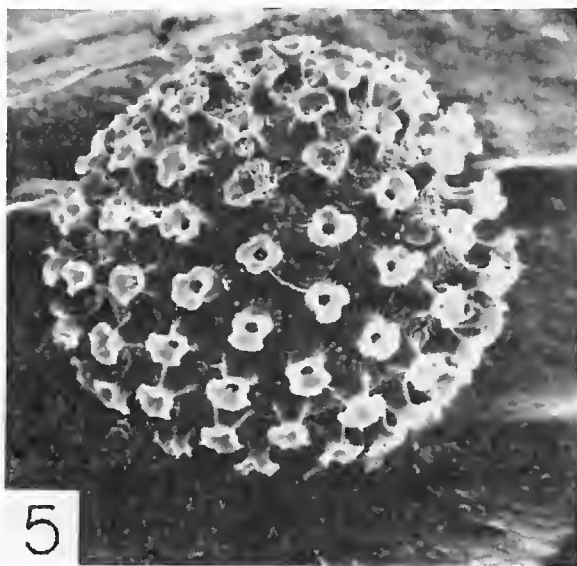
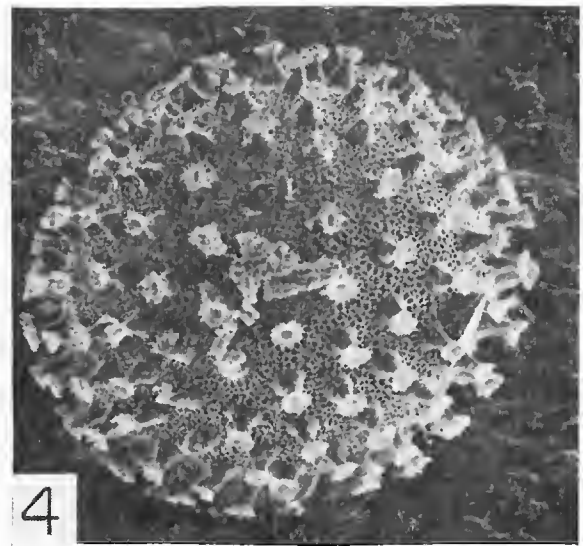
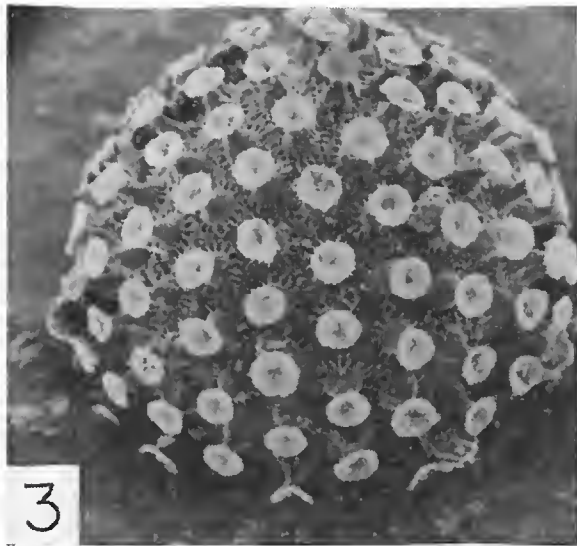
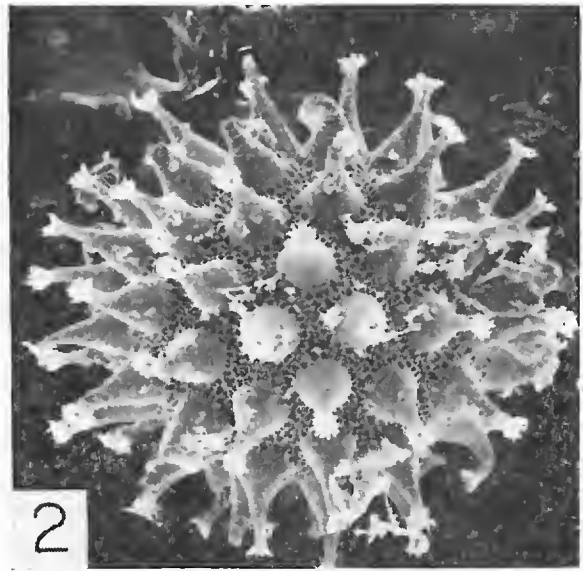
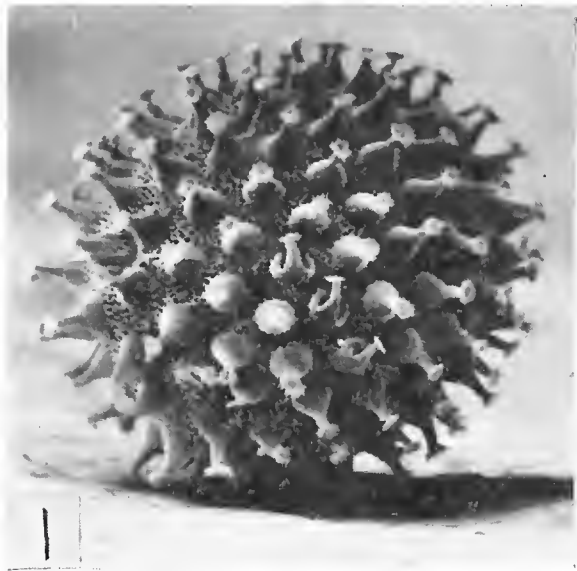
Macrobotus sp. ? *hufelandii* (table 1, fig. 5)—a single example of an egg of *hufelandii* from California differs from the above examples in having a wrinkled shell and a total absence of pores. The processes are hollow with internal openings basally to each of the ridges radiating outward from the processes. The space between the inner and outer shell walls thus contains an appreciable amount of air space although the shell is not porous. If further study doesn't provide intergrades between the forms, the Californian population will need to be recognized as a distinct entity.

Macrobotus hufelandii recens Cuénot, 1932 (table 1, fig. 1)—the egg of this species in no way resembles the illustration by Cuénot but agrees exactly with that illustrated by Ramazzotti (1972) as an egg probably representing *recens*. The former *recens* egg has about twice as many processes of lesser diameter and processes without distal discs. The variation is inordinate and the species represented in figure 1 may eventually be recognized as distinct. Of the kinds of eggs considered here, this one has the greatest total number of pores and largest pore perimeter.

Macrobotus anderssoni Richters, 1907 (table 1, fig. 2)—examples of this species agree with the figure accompanying the original description. The small number of long processes with microdentate rings and the extremely porous shell surface is distinctive.

Macrobotus hibiscus Barros, 1942 (table 1, fig. 4)—six eggs of *hibiscus* were from four widely separated localities. . . Tanzania, Italy, Finland and California. The eggs are small with many widely spaced small processes. The interprocess area is comprised of pores differing greatly in size.

Macrobotus sp. nr. *hibiscus* (table 1, fig. 6)—a few eggs of a general *hibiscus* configuration appear to represent undescribed species. One example of these is a large egg with many closely spaced processes and few pores in the reduced shell area. Any understanding of the significance of these various eggs is dependent on the accumulation of sufficiently large numbers to allow a statistical analysis of their variation.



Macrobotus pseudohufelandii Iharos, 1966—we haven't seen an example of this egg which is described as having squat cone-shaped processes about 5μ high and 5μ wide at the base. The description indicates some 35–40 processes per hemisphere but the illustration has over 80. The shell is supposedly smooth.

Macrobotus inermis Binda and Pilato, 1971—One extremely flattened egg was examined following removal from a slide preparation. The original description of this egg was essentially correct except the shell surface has about 45 minute pores in each area bordered by the bases of any four processes.

Closely spaced, short cone-shaped processes with small terminal discs have walls that are apparently smooth but a granular texture is evident at magnifications above $5,000\times$.

The eggs in *inermis* and *pseudohufelandii* appear to be extremely similar. Examination of eggs of the latter species by SEM will be required to resolve the question of possible synonymy.

LITERATURE CITED

- ANDERSON, T. F. 1951. Techniques for the Preservation of Three-dimensional Structure in Preparing Specimens for the Electron Microscope, Trans. N. Y. Acad. Sci., Series II, 13: 130–134.
- BARROS, R. DE. 1942. Tardigrados do Estado de São Paulo, Brazil II, Genero "Macrobotus", Rev. Brasil. Biol., 2: 257–269.
- BINDA, M. G. AND G. PILATO. 1971. Nuovo contributo all conoscenza dei Tardigradi di Sicilia. Boll. Sedute Accad. Gioenia Sc. Nat., Catania IX: 623–633.
- DOYÈRE, M. P. L. N. 1840. Mem. Sur Les Tardigrades, Ann. Soc. Nat. 14 p. 269.
- IHAROS, G. 1966. Beitrage zur kenntnis der Tardigraden-Fauna Osterreichs. Acta Zool. Academiae Scientiarum Hungaricae XII: 123–127.
- RAMAZZOTTI, G. 1972. IL. Phylum Tardigrada Mem. Ist. Ital. di Idrobiol. 28, 732 p.
- RICHTERS, F. 1907. Antarktische Tardigraden. Zool. Anz. Leipzig 31: 915–916.
- SCHULTZ, C. A. S. 1833. Beschreibung des Macrobotus hufelandii. Isis von Oken pp. 708–713.

<

FIGS. 1–6. Scanning electron microscope photographs of eggs of *Macrobotus*
 1. *M. hufelandii recens* Cuénot, $700\times$ (Mt. Aspiring National Park, South Island, New Zealand). 2. *M. anderssoni* Richters, $470\times$ (Abel Tasman National Park, South Island, New Zealand). 3. *M. hufelandii* Schultze, $500\times$ (Oland, Sweden). 4. *M. hibiscus* Barros, $675\times$ (Muonio, Finland). 5. *M. ? hufelandii*, $455\times$ (Auburn, California). 6. Undescribed sp. nr. *hibiscus* $500\times$ (Triangulation Station, Chatham Islands, Rangatira Island, New Zealand).

Mealybugs of San Miguel Island, California

(Homoptera: Coccoidea: Pseudococcidae)

DOUGLASS R. MILLER

Systematic Entomology Laboratory, USDA, ARS, Beltsville, Maryland 20705

In an earlier paper (Miller, 1971) I described the mealybug fauna of Santa Cruz Island, and discussed the California Island biota, including brief statements on island name terminology, endemism, and disjunctions.

In July 1970 I collected on San Miguel Island for nine days. Although this was far from an adequate amount of time to collect specimens of each mealybug species on the island, I think it was sufficient to permit me to adequately compare the origins and relationship of the pseudococcid faunas of San Miguel and Santa Cruz Islands.

San Miguel is approximately 14 square miles in land area, is 26 miles from the nearest point on the mainland, is three miles from the nearest island (Santa Rosa), and is 21 miles from Santa Cruz Island (Philbrick, 1967). The highest elevation, 831 feet, is on San Miguel Mountain. The general topography of the island has been described by Bremner (1933) as follows: "Most of the surface of the island is a wave-cut terrace from 400 to 500 feet in elevation above which rise two hills. . . . (San Miguel and Green Mountains).A lower terrace from 20 to 100 feet in elevation borders the south coast. . . .The island has been eroded but little since the terraces were cut. Two streams heading on the flanks of Green Mountain and flowing northward and southward respectively, have cut deep narrow canyons. . . .Another steep narrow canyon heads on the terrace near the ranch house and drains northward to Cuyler Harbor. The island when first visited by Europeans, was covered with a dense growth of brush. . . .Cattle and sheep were placed on the island. . . .and allowed to multiply without restriction, with the result that much of the vegetation was destroyed. The strong prevailing winds from the northwest then formed dunes of drifting sand that now cover most of the surface." Sand beaches are common and surround about $\frac{3}{4}$ of the island. The only trees are several recently introduced palms. The flora contains no taxa which occur exclusively on San Miguel, although there are nine plant species, subspecies, or varieties which have been recorded on San Miguel and at least one other California Island but are not known on the mainland (Raven, 1967). The herpetofauna includes one salamander and two lizards, none of which

are insular endemics (Savage, 1967). The terrestrial mammal fauna consists of a bat, an endemic subspecies of deer mouse, and an endemic race of gray fox. The fox species is an insular endemic (von Bloeker, 1967). Marine mammals are abundant on the beaches and off-shore waters of San Miguel. In recent years four or five species of seals and sea lions have been reported (Bartholomew, 1967) in addition to the sea otter (Allanson, 1955). A general study of the insect and bird faunas of San Miguel has not been published to my knowledge.

The recent geologic history of the California Islands is not well understood. San Miguel apparently was last submerged during the First Interglacial period of the Pleistocene (Orr, 1967). The time of the last land connection to the mainland is not well established—late Pliocene to mid-Pleistocene (Orr, 1967), mid-Pleistocene (Valentine and Lipps, 1967), or late Pleistocene and sub-Recent (Weaver and Doerner, 1967). All seem to agree that if a connection actually occurred, it was as a peninsular extension of the Santa Monica Mountains. After the last continental land connection, there is evidence that San Miguel was joined to the other Northern Channel Islands at least during the late Pleistocene (Valentine and Lipps, 1967).

SAN MIGUEL ISLAND MEALYBUGS

The following list includes 12 genera and 13 species. The localities may be found on the accompanying map (Fig. 1). Plant names are as listed by Munz and Keck (1965). The only previous mention of a mealybug on San Miguel was by Cockerell (1938) who stated, "A kind of mealy-bug, perhaps new, was found on *Astragalus miguelensis*." The unnamed mealybug was most likely *Pseudococcus obscurus*.

Amonostherium

lichtensioides (Cockerell)

1. Green Mountain, 11 July 1970, *Artemisia californica* (foliage)
2. Harris Point, 10 July 1970, *A. californica* (foliage)

Chorizococcus

abroniae McKenzie

1. Cuyler Harbor, 12 July 1970, *Franseria* sp. (decumbent branches)

Distichlicoccus

salinus (Cockerell)

1. Bay Point, 12 July 1970, *Distichlis spicata* (on leaf blade)
2. Cuyler Harbor, 9 July 1970, *Distichlis spicata* (on leaf blade)

Heterococcus

arenae Ferris

1. San Miguel Mountain, 11 July 1970, grass (in leaf sheath)



FIG. 1. San Miguel Island mealybug collection sites 1. Bay Point 2. Cuyler Harbor 3. Green Mountain 4. Harris Point 5. San Miguel Mountain 6. Simonton Cove 7. Ranch south of Cuyler Harbor.

Paludicoccus

distichlium (Kuwana)

1. Cuyler Harbor, 9 July 1970, *Distichlis spicata* (in leaf sheath)

Phenacoccus

colemani Ehrhorn

1. Harris Point, 10 July 1970, *Dudleya* sp. (on roots)

gossypii Townsend and Cockerell

1. Simonton Cove, 10 July 1970, *Haplopappus* sp. (on foliage)

Pseudococcus

obscurus Essig

1. Bay Point, 12 July 1970, *Coreopsis gigantea* (on roots)
2. 1 mi. S. Bay Point, 12 July 1970, *Astragalus* sp. (on roots)
3. Cuyler Harbor, 12 July 1970, *Coreopsis gigantea*, *Eriogonum* sp., *Franseria chamissonis* (on roots)
4. Green Mountain, 11 July 1970, *Lotus* sp., *Mesembryanthemum* sp. (on roots)
5. Ranch S. of Cuyler Harbor, 9 July 1970, *Astragalus* sp., *Baccharis* sp., *Lupinus* sp. (on roots)
6. San Miguel Mountain, 11 July 1970, *Mesembryanthemum* sp. (on roots)
7. Simonton Cove, 10 July 1970, *Abronia* sp., *Astragalus* sp., *Eriogonum* sp. (on roots)
8. 0.5 mi. S. E. Simonton Cove, 10 July 1970, composite (on roots)

Puto

yuccae (Coquillett)

1. Bay Point, 12 July 1970, *Atriplex semibaccata* (on roots)

2. Cuyler Harbor, 9 and 10 July 1970, *Abronia* sp., *Atriplex semibaccata*, *Eriogonum* sp., *Mesembryanthemum* sp. (on foliage)

*Rhizoecus**gracilis* McKenzie

1. Bay Point, 12 July 1970, composite (on roots)

*Spilococcus**keiferi* McKenzie

1. Cuyler Harbor, 9 July 1970, *Eriogonum* sp. (on foliage)

*Tridiscus**distichlii* Ferris

1. San Miguel Mountain, 11 July 1970, *Distichlis spicata* (in leaf sheath)

*Trionymus**smithii* (Essig)

1. Green Mountain, 11 July 1970, grass (in leaf sheath)
2. 0.5 mi. S. E. Simonton Cove, 11 July 1970, grass (in leaf sheath).

DISCUSSION

Based on the work of McKenzie (1967) there are approximately 40 species of mealybugs which have been collected on hosts that occur on San Miguel Island and are found in the coastal mainland areas adjacent to the Northern Channel Islands. Of the 40 species, only 13 have been collected on San Miguel. Three of the 13 are distributed throughout most of California, three occur in saline regions along the coast, two occur in the coastal mountain ranges and beaches, two in the coastal ranges, southern deserts, and Sierra-Nevada Mountains, two in the coastal ranges and the Sierra Nevada, and one exclusively on beaches. All mealybug species that occur on San Miguel very probably are present in the coastal mountains or beaches of the immediate California mainland. It is therefore likely that the San Miguel pseudococcid fauna is a depauperate aggregation of mealybug species which are closely allied to the adjacent mainland fauna. Based on these assumptions, it is logical to conclude that San Miguel has been colonized from the adjacent California mainland via the other Northern Channel Islands.

Perhaps the most interesting aspect of the San Miguel mealybug fauna is displayed by *Pseudococcus obscurus*. This species was encountered in great abundance at nearly every collecting site. Although it is a common California mealybug, I have never before seen it in such numbers or in so many different kinds of habitats as on San Miguel. Although it is tempting to suggest that this expanded insular diversity is caused directly by the availability of vacant feeding sites, alternative explanations such as lack of natural enemies are possible.

COMPARISON OF THE MEALYBUG FAUNAS OF SAN MIGUEL
AND SANTA CRUZ ISLANDS

There are several noticeable differences in the Santa Cruz and San Miguel mealybug faunas. (1) The Santa Cruz fauna contains nearly twice as many mealybug species as that of San Miguel. Of the 13 species present on San Miguel, only two are unrecorded on Santa Cruz, whereas of the 23 species on Santa Cruz, 12 are unknown on San Miguel. The reason for these differences seems evident since Santa Cruz is larger in size, is closer to the mainland, has a greater habitat diversity, and apparently has been continuously emergent for a longer period of time. (2) Although Santa Cruz supports a much larger number of pseudococcid species, individuals are relatively rare. On San Miguel however, the species number is small, but individuals, particularly of *Pseudococcus obscurus*, are abundant. Furthermore, on Santa Cruz there is no evidence of unusual ecological diversity, but on San Miguel *P. obscurus* is not only exceptionally abundant, but also occurs on many previously unrecorded hosts. These differences very possibly are unrelated to insular phenomena. Many pseudococcids prefer sandy, well drained soils, particularly those species that occur in the moist coastal regions. On Santa Cruz this type of habitat is present but uncommon, whereas on San Miguel nearly the entire island is covered by sand. Presumably, once an oligophagous species such as *P. obscurus* has successfully colonized San Miguel and has adapted to a sandy habitat, it can easily spread and become abundant. On Santa Cruz once an oligophagous species has become established, in order to successfully inhabit large geographic areas, it must adapt not only to many hosts, but also to varied types of habitats, many of which are not very successfully colonized even on the mainland. (3) On Santa Cruz, there are five pseudococcid species which do not occur on the closest mainland but do occur farther north in California. On San Miguel no disjunctions were found; all species apparently occur on the adjacent mainland. (4) On Santa Cruz the genus:species ratio was about 1:2; on San Miguel the ratio was approximately 1:1.

There are two similarities in these insular faunas. (1) Both lack the endemic taxa encountered in other parts of their respective biotas. (2) Both are depauperate aggregations of species similar to the pseudococcid fauna on the adjacent mainland.

SUMMARY

Twelve genera and 13 species of mealybugs are known on San Miguel Island, none of which are endemic. The pseudococcids comprise a de-

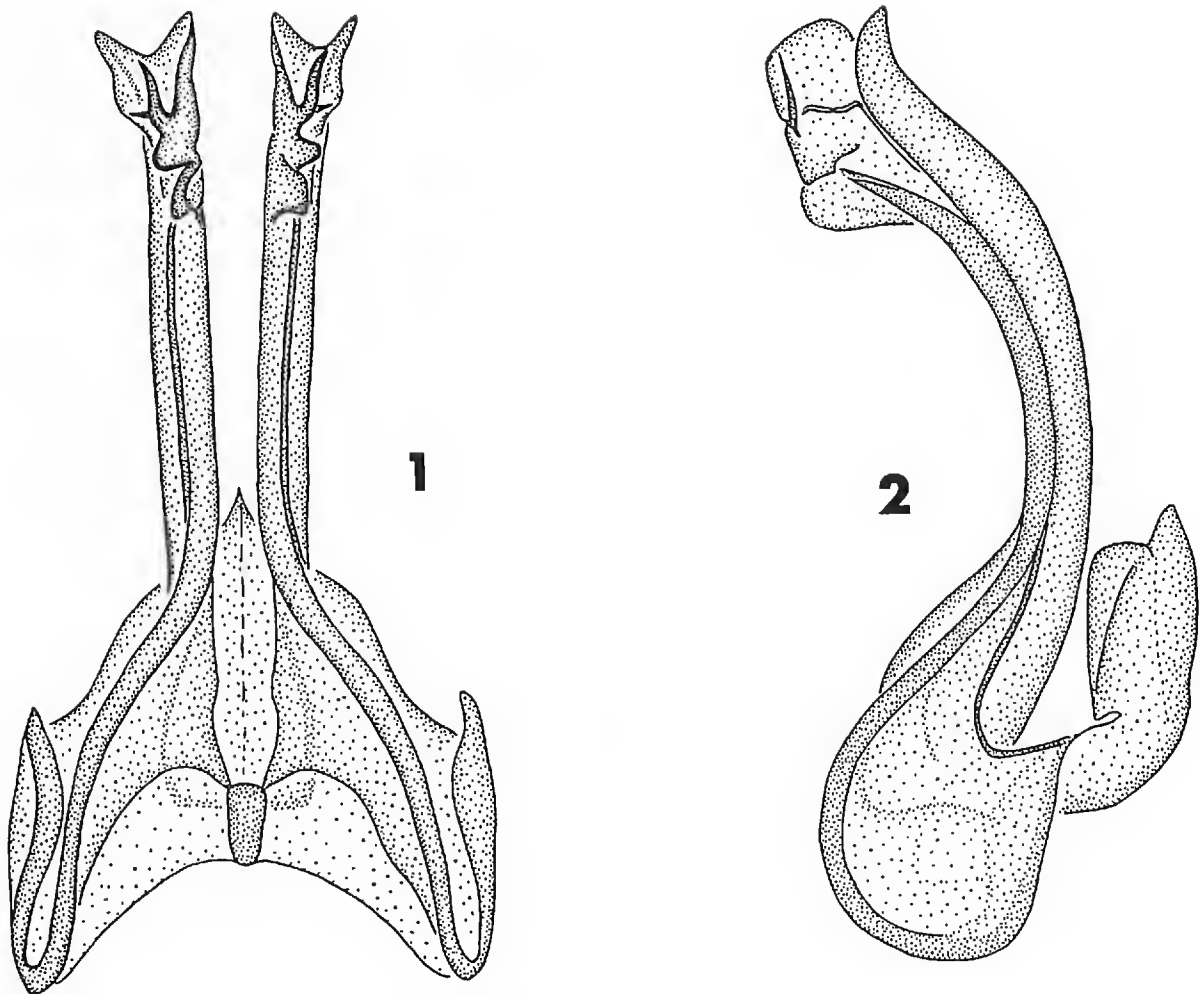
pauperate aggregation of species similar to the mealybug fauna of the adjacent mainland. One species, *Pseudococcus obscurus*, appears to be much more abundant and to occupy more diverse habitats on San Miguel than on the mainland or on Santa Cruz Island.

ACKNOWLEDGMENTS

I thank Mr. Robert O. Schuster and Dr. Albert A. Grigarick, University of California, Davis, for making arrangements for this trip to San Miguel, for assisting in the collection of scale insects while on the island, and for criticizing the manuscript. I also thank Louise M. Russell, Dr. Arnold S. Menke and Dr. Willis W. Wirth, Systematic Entomology Laboratory, ARS, USDA, for reviewing and criticizing this manuscript.

LITERATURE CITED

- ALLANSON, A. 1955. Sea otters on San Miguel. *Pac. Discovery*, 8: 24-25.
- BARTHOLOMEW, G. A. 1967. Seal and sea lion populations of the California Islands. Pp. 229-244 in R. N. Philbrick (ed.), (For complete citation see Philbrick).
- BREMNER, C. ST. J. 1933. Geology of San Miguel, Santa Barbara County, California. *Santa Barbara Mus. Nat. Hist. Occas. Papers*, (2): 1-23.
- COCKERELL, T. D. A. 1938. San Miguel Island, California. *Sci. Monthly*, 46(2): 180-187.
- McKENZIE, H. L. 1967. Mealybugs of California with taxonomy, biology and control of North American species. Univ. Calif. Press, Berkeley, 525 pp.
- MILLER, D. R. 1971. Mealybugs of Santa Cruz Island, California. *Pan-Pac. Entomol.*, 47(4): 293-303.
- MUNZ, P. A. AND D. D. KECK. 1965. *A. California Flora*. Univ. Calif. Press, Berkeley, 1681 pp.
- ORR, P. C. 1967. Geochronology of Santa Rosa Island, California. Pp. 317-325 in R. N. Philbrick (ed.), (For complete citation see Philbrick).
- PHILBRICK, R. N. 1967. Introduction. Pp. 3-8 in R. N. Philbrick (ed.), *Proceedings of the Symposium on the Biology of the California Islands*. Santa Barbara Botanic Garden, Calif., 341 pp.
- RAVEN, P. H. 1967. The floristics of the California Islands. Pp. 57-67 in R. N. Philbrick (ed.), (For complete citation see Philbrick).
- SAVAGE, J. M. 1967. Evolution of the insular herpetofaunas. Pp. 219-227 in R. N. Philbrick (ed.), (For complete citation see Philbrick).
- VALENTINE, J. W. AND J. H. LIPPS. 1967. Late Cenozoic history of the Southern California Islands. Pp. 21-35 in R. N. Philbrick (ed.), (For complete citation see Philbrick).
- VON BLOEKER, J. C., JR. 1967. Land mammals of the Southern California Islands. Pp. 245-263 in R. N. Philbrick (ed.), (For complete citation see Philbrick).
- WEAVER, D. W. AND D. P. DOERNER. 1967. Western Anacapia—A summary of the Cenozoic history of the Northern Channel Islands. Pp. 13-20 in R. N. Philbrick (ed.), (For complete citation see Philbrick).



FIGS. 1-2. *Tynomma schlingeri*, holotype male. Fig. 1. Gonopods, posterior aspect. Fig. 2. Left gonopod, lateral aspect.

mary crests, including three suprarepugnatorial crests. Setae of primary dorsal crests equalling one-half length of crest on anterior segments and one-third crest length on middle body segments; setae moving to caudal end of crest on sixth segment, projecting mesocaudad on that and succeeding segments, not enlarged caudally; secondary crests large, subequal to primary crests on anterior segments, becoming gradually reduced caudad, nearly obsolete on posterior third of body, two secondary crests between two dorsal primary crests, one between others. Body tapering gradually caudad; epiproct with lateral margins straight, exceeding anal valves, with one pair of paramedial dorsal setae and two pairs of lateral marginal setae; spinnerets prominent, produced caudad just below caudal margin or epiproct; a pair of setae subtending spinnerets; anal valves smooth, with one pair of setae removed from anal lips; anal lips narrow, slightly protruding; hypoproct lenticular, with two pairs of setae. Legs seven segmented, with transverse sutures on tarsi of mid-body legs; podites from longest to shortest as follows: 7, 3, 4, 6, 5, 1, 2; legs one and two six-segmented, reduced; about half length of normal walking legs, with large, erect setae on mesal surface of podites; tarsi with dense comb mesally; second coxa with small, acute anterior process and large cylindrical posterior gland; third and succeeding legs with velutinous pad on mesal face of tarsus; legs 3 through 24 with eversible coxal glands distally; beginning with leg 16, alternate legs with coxa produced in subconical caudal process; beginning with

leg 48, and continuing to leg 80, those legs with caudal process also with rounded, sclerotized anterior lamina; succeeding legs normal. Gonopods anteriorly fused, forming a single subtriangular ventral lamina with sinuous lateral margins, acute apex, and median vertical carina; posteriorly, produced separately in long, sub-cylindrical, narrow pieces greatly exceeding anterior lamina; distally expanded, with rounded subapical posterior lamina, wide mesal lamina with small, crescent-shaped solenomerite, and rounded anterolateral lamina. Length: 30 mm.

PARATYPE FEMALE.—As in male except for sexual characters.

SPECIMENS EXAMINED. Holotype male.—CALIFORNIA: STANISLAUS COUNTY: DEL PUERTO CANYON, el. 1200 ft., FRANK RAINES PARK, 13 April 1973 (E. I. Schlinger). Paratypes. 4 females, same data as holotype. All types will be placed in the type collection of the California Academy of Sciences, San Francisco.

DISCUSSION.—This distinctive species is closely related to *magnum* as indicated by several features. Both are large, have a short anterior gonopod and long posterior gonopod, rounded laminae on alternate coxae, sutures on tarsi, and transition to full crest number occurring on adjacent segments.

The type locality for *schlingeri* is an isolated canyon in the inner coast ranges. In addition to the present species, an undescribed species of *Caseya* (fam. Caseyidae) occurs there. Neither species has been collected elsewhere.

LITERATURE CITED

- BUCKETT, J. S., AND M. R. GARDNER. 1969. Revision of the chordeumid milliped genus *Tynomma* Loomis from California. Pan-Pac. Entomol., 45: 204–216.

Two New Subspecies of the *Drosophila willistoni* Group(Diptera: Drosophilidae)¹

FRANCISCO J. AYALA

Department of Genetics, University of California, Davis, California 95616

The genus *Drosophila* (Drosophilidae, Diptera) is characterized by the existence of groups of two or more sibling species, i.e., species morphologically so similar as to be practically indistinguishable. Dobzhansky (1956) has speculated that the evolution of external morphology has reached in the genus *Drosophila* a high degree of perfection and that the adaptive evolution proceeds largely through physiological channels. This hypothesis has recently been supported by evidence showing that sibling species of *Drosophila* often differ in their allozymes, that is, in enzymes coded for by different alleles at the same genetic locus. Ayala and Powell (1972) have shown that allozymes can be used as species diagnostic characters.

Since little morphological differentiation often exists between closely related species, it is not surprising that the taxonomic category of subspecies has rarely been used in *Drosophila*, in spite of extensive study of the genus. Whenever races or subspecies have been distinguished in *Drosophila*, the distinction has, in most cases, been based on the occurrence of incipient reproductive isolation and/or differences in the frequencies of chromosomal inversions. In this paper I present evidence showing that one pair of subspecies can be distinguished in each of the species, *Drosophila willistoni* and *D. equinoxialis*. The subspecies can be identified by their allozyme patterns, and these are used in their formal description. I believe this is the first time that allozymes have been used in the formal description of a taxon.

REPRODUCTIVE ISOLATION

The *Drosophila willistoni* group contains at least six sibling species endemic in the New World tropics (Spassky *et al.*, 1971). Two of the siblings, *D. insularis* Dobzhansky and *D. pavlovskiana* Dobzhansky and Kastritsis, are narrow endemics; the former on some islands of the Lesser Antilles and the latter in Guyana. The other four species, *D. willistoni* Sturtevant, *D. equinoxialis* Dobzhansky, *D. paulistorum* Dobzhansky and Pavan, and *D. tropicalis* Dobzhansky and Pavan have

¹ Work supported by NSF grant GB 30895.

wide geographic distributions, which overlap through Central America and the northern half of continental South America.

The distribution of *D. willistoni* extends from northern Mexico and south Florida, through Central America, the Caribbean islands, and continental South America down to La Plata in Argentina. *D. willistoni* adults were collected in 1954 by Prof. C. Pavan and again in 1972 by Prof. D. Brncic near Lima, Peru. The Lima flies from either sample exhibit incipient reproductive isolation from flies collected in Colombia, Venezuela, Trinidad and Brazil. Crosses having Lima flies as the male parent produce fertile hybrids of both sexes. Females from Lima crossed to males from the other localities yield fertile females but sterile male hybrids. The populations near Lima are therefore assigned to a new subspecies, *D. willistoni quechua* Ayala.

The known distribution of *D. equinoxialis* extends from central Mexico, through Central America, the greater Antilles, and the northern half of continental South America, including the Amazon basin. Flies from Hispaniola, Puerto Rico and Costa Rica, exhibit incipient reproductive isolation from flies collected in eastern Panama or anywhere in continental South America. The populations from Hispaniola, Puerto Rico, and Costa Rica are therefore included in a second new subspecies, *D. equinoxialis caribbensis* Ayala. Crosses between *D. e. equinoxialis* and *D. e. caribbensis* produce fertile females but sterile males.

ENZYME DIFFERENTIATION

Using techniques for starch gel electrophoresis and enzyme assay described elsewhere (Ayala *et al.*, 1972), we have studied genetic variation at 23 to 30 gene loci coding for enzymes. The relevant results are summarized in Table 1. At each of 5 out of 25 loci studied in both subspecies there are substantial differences in the enzyme patterns, and therefore in the genotypic constitution of *D. w. willistoni* and *D. w. quechua*. Also at each of 5 out of 25 loci studied in both subspecies substantial differences exist between *D. e. equinoxialis* and *D. e. caribbensis*. Using the method of Ayala and Powell (1972) it is possible to calculate the probability of correct diagnosis of the subspecies of a single individual of known genotype. This probability ranges from 0.99998 to 0.974 for each of the five diagnostic loci in *D. willistoni*; using jointly the five loci, the probability of incorrect diagnosis of the subspecies of a single individual is 3.4×10^{-14} . The probability of correct attribution for each of the five diagnostic loci ranges in *D. equinoxialis* from 0.9997 to 0.967; using jointly the five loci the prob-

TABLE 1. Allelic frequencies at several diagnostic loci in two pairs of subspecies of *Drosophila*. Alleles designed by their relative electrophoretic mobility; some rare alleles have been omitted from the Table. Sample size is the number of wild genes sampled; i.e., twice the number of wild-collected individuals studied, except for sex-linked loci which exist in males in single dose. The symbols for the loci refer to the enzymes coded for by them, as follows: *Est* = esterase; *Odh* = octanol dehydrogenase; *Xdh* = xanthine dehydrogenase; *AcpH* = acid phosphatase; *Mdh* = malate dehydrogenase; *G3pdh* = glyceraldehyde-3-phosphate dehydrogenase; *Hk* = hexokinase.

Subspecies	Sample size	Locus and alleles					Probability of correct diagnosis of the subspecies
A.							
				<i>Est-2</i>			
		98	100	102	104		
<i>D. w. willistoni</i>	7012	.003	.041	.941	.006		.999
<i>D. w. quechua</i>	108	.231	.769	.000	.000		
				<i>Est-4</i>			
		98	100	102	104		
<i>D. w. willistoni</i>	9692	.004	.146	.838	.011		.989
<i>D. w. quechua</i>	114	.000	1.000	.000	.000		
				<i>Est-7</i>			
		96	98	100	102	105	
<i>D. w. willistoni</i>	6819	.025	.147	.563	.211	.049	.974
<i>D. w. quechua</i>	59	.847	.000	.153	.000	.000	
				<i>Odh-1</i>			
		96	100	104			
<i>D. w. willistoni</i>	1088	.039	.882	.071			.994
<i>D. w. quechua</i>	64	.016	.000	.984			
				<i>Xdh</i>			
		95	97	98	100	101	
<i>D. w. willistoni</i>	2320	.000	.007	.114	.468	.322	.99998
<i>D. w. quechua</i>	64	.547	.422	.000	.000	.000	
B.							
				<i>Est-4</i>			
		98	100	102			
<i>D. e. equinoxialis</i>	2682	.150	.769	.081			.967
<i>D. e. caribbensis</i>	2166	.954	.036	.001			

TABLE 1. (Continued)

Subspecies	Sample size	Locus and alleles							Probability of correct diagnosis of the subspecies
		<i>AcpH-1</i>							
		88	94	100	102	104	106	108	
<i>D. e. equinoxialis</i>	702	.000	.013	.172	.000	.811	.000	.014	.986
<i>D. e. caribbensis</i>	2062	.635	.027	.113	.005	.019	.176	.010	
		<i>Mdh-2</i>							
		94	106						
<i>D. e. equinoxialis</i>	1900	.994	.000						.9997
<i>D. e. caribbensis</i>	1572	.0006	.989						
		<i>G3pdh</i>							
		92	96	100					
<i>D. e. equinoxialis</i>	32	.000	.063	.906					.977
<i>D. e. caribbensis</i>	754	.019	.939	.029					
		<i>Hk-1</i>							
		96	100						
<i>D. e. equinoxialis</i>	428	.082	.914						.975
<i>D. e. caribbensis</i>	988	.982	.009						

ability of misclassification of a single individual of known genotype is 8.0×10^{-11} .

It should be noted that in the formal descriptions which follow, the frequency with which individuals exhibit a given band is calculated on the basis of *genotypic* frequencies. These frequencies can be calculated from the data given in Table 1 by assuming Hardy-Weinberg equilibrium.

***Drosophila willistoni* Sturtevant**

This species becomes the nominate subspecies, *Drosophila willistoni willistoni* Sturtevant.

***Drosophila willistoni quechua* Ayala, new subspecies**

Morphologically indistinguishable from *Drosophila willistoni willistoni* as described by Sturtevant (1921), but differing from it by allozyme patterns in electrophoretic assays for following enzymes. (1) *Xanthine dehydrogenase*: in buffer system of pH 9.0, bands migrating anodally less than bands exhibited by *D. w. willistoni*. (2) *Esterase-2*: in buffer system of pH 8.65, bands migrating anodally less than bands exhibited by *D. w. willistoni*. (3) *Octanol dehydro-*

genase-1: in buffer system of pH 9.0, nearly always (more than 99.9 percent of individuals) exhibits band with further anodal migration than common bands of *D. w. willistoni*. (4) *Esterase-4*: in buffer system of pH 8.65, band migrating anodally less than most common band exhibited by *D. w. willistoni*. (5) *Esterase-7*: in buffer system of pH 8.65 nearly always (98 percent of the individuals) with a band migrating anodally less than common bands of *D. w. willistoni*.

Holotype male, laboratory reared, original stock from PERU: Department of Lima, near Lima, collected by net sweeping over fruit baits in June 1972 by Prof. Danko Brncic, reared at Department of Genetics, University of California, Davis by F. J. Ayala, killed 6-IV-1973. Allotype and 497 paratypes (207 males, 290 females), same data as holotype, with paratypes also dated 10-IV-1973, either point mounted or preserved in alcohol. Holotype and allotype, point mounted, deposited in the California Academy of Sciences, Department of Entomology, Type Number 11786. Paratypes deposited in the collections of the California Academy of Sciences, National Museum of Natural History, Washington, D.C., and University of California collections at Berkeley, Davis, and Riverside.

The original stock consisted of 38 inseminated females, maintained in separate cultures. Crosses made among the 38 cultures. The holotype, allotype and paratypes are progenies from these crosses.

***Drosophila equinoxialis* Dobzhansky**

This species becomes the nominate subspecies, *Drosophila equinoxialis equinoxialis* Dobzhansky.

***Drosophila equinoxialis caribbensis* Ayala, new subspecies**

Morphologically indistinguishable from *Drosophila equinoxialis equinoxialis* as described by Dobzhansky (1946), but differing from it by allozyme patterns in electrophoretic assays for following enzymes. (1) *Malate dehydrogenase-2*: in buffer system of pH 9.0, nearly always (more than 99.999 percent of individuals) exhibiting band with further anodal migration than most common band of *D. e. equinoxialis*. (2) *Acidphosphate-1*: in buffer system of pH 8.65, nearly always (more than 99.9 percent of individuals) with bands migrating anodally either less (most often) or more than most common band of *D. e. equinoxialis*. (3) *Glyceraldehyde-3-phosphate dehydrogenase*: in buffer system of pH 7.0, nearly always (more than 99.9 percent of individuals) exhibiting bands with less anodal migration than most common band of *D. e. equinoxialis*. (4) *Hexokinase-1*: in buffer system of pH 7.0, nearly always (more than 99.9 percent of individuals) exhibiting bands with less anodal migration than most common band of *D. e. equinoxialis*. (5) *Esterase-4*: in buffer system of pH 8.65, nearly always (more than 99.8 percent of individuals) exhibiting bands with less anodal migration than most common band of *D. e. equinoxialis*.

Holotype male, laboratory reared, original stock from PUERTO RICO: Mayagüez, collected 24-II-1972 by net sweeping over fruit baits by F. J. Ayala, reared at Department of Genetics, University of California, Davis by F. J. Ayala, killed 6-IV-1973. Allotype and 214 paratypes (103 males, 111 females) same data as holotype, with some paratypes killed 10-IV-1973, either point mounted or preserved in alcohol. Holotype and allotype, point mounted, deposited in the California Academy of Sciences, Department of Entomology, Type Number 11787. Paratypes deposited in the collections of the California Academy of Sciences, National Museum of Natural History, Washington, D.C., and University of California collections at Berkeley, Davis, and Riverside.

The original stock consisted of 151 females, maintained in separate cultures. Crosses were made among the 151 cultures. The holotype, allotype and paratypes are progenies from these crosses.

Geographic Distribution: Puerto Rico, Hispaniola and Costa Rica (Limón province).

SUMMARY

Two new subspecies of the *Drosophila willistoni* group are described. The subspecies are established on the basis of partial reproductive isolation (hybrid sterility) between allopatric populations. Members of each pair of subspecies differ from each other by the patterns of their enzymes as assayed by gel electrophoresis. Using five different enzymes, the probability of incorrect identification of the subspecies of an individual of known genotype is less than 1×10^{-10} . This is the first time that allozyme patterns have been used in the formal description of a taxon.

LITERATURE CITED

- AYALA, F. J., AND J. R. POWELL. 1972. Allozymes as diagnostic characters of sibling species of *Drosophila*. Proc. Nat. Acad. Sci., USA, 69: 1094-1096.
- AYALA, F. J., J. R. POWELL, M. L. TRACEY, C. A. MOURÃO, AND S. PÉREZ-SALAS. 1972. Enzyme variability in the *Drosophila willistoni* group. IV. Genetic variation in natural populations of *Drosophila willistoni*. Genet., 70: 113-139.
- DOBZHANSKY, T. 1946. Complete reproductive isolation between two morphologically similar species of *Drosophila*. Ecol., 27: 205-211.
- DOBZHANSKY, T. 1956. What is an adaptive trait? Amer. Nat., 90: 337-347.
- SPASSKY, B., R. C. RICHMOND, S. PÉREZ-SALAS, O. PAVLOVSKY, C. A. MOURÃO, A. S. HUNTER, H. HOENIGSBERG, T. DOBZHANSKY, AND F. J. AYALA. 1971.

Geography of the sibling species related to *Drosophila willistoni* and of the semispecies of the *Drosophila paulistorum* complex. *Evol.*, 25: 129-143.

STURTEVANT, A. H. 1921. The North American species of *Drosophila*. Carnegie Inst. Washington Publ. 301, pp. 1-150.

SCIENTIFIC NOTE

Speculation on the distribution of the Southern California species of *Cafius* with a new record from the Salton Sea (Coleoptera: Staphylinidae)

—Members of the genus *Cafius* are found throughout the world along the seashore and on the banks of rivers near the sea. Of the seven species of *Cafius* known from southern California, one (*C. canescens* Mäklin) is abundant, three (*C. seminitens* Horn, *C. lithocharinus* LeConte and *C. luteipennis* Horn) are sometimes common and three (*C. sulcicollis* LeConte, *C. opacus* LeConte and *C. decipiens* LeConte) are rare. *Cafius canescens* is known from Alaska to Baja California, *C. seminitens* and *C. luteipennis* from British Columbia to Baja California, *C. lithocharinus* from Washington to Baja California, *C. sulcicollis* from southern California and Baja California and the very rare *C. decipiens* has been recorded only twice from San Diego (LeConte 1863, *Smithson. Misc. Coll.*, 167: 1-92; Casey 1885, *Bull. Calif. Acad. Sci.*, 1: 285-336). *Cafius sulcicollis*, recorded from Magdalena Island, Baja California (Horn 1894, *Proc. Calif. Acad. Sci.*, 4: 302-449), is the only species known to occur in the southern part of the poorly explored peninsula of Baja California. On March 3, 1968, Kenneth W. Cooper collected three specimens of *C. sulcicollis* at Desert Beach, Salton Sea, Riverside County, California. These specimens are in the collection of the University of California at Riverside. To our knowledge, this is the first record of any species of seashore beetle from the shores of the Salton Sea. *Bledius ferratus* LeConte, a coastal species which has been reported from the Salton Sea (Herman 1972, *Bull. Amer. Mus. Nat. Hist.*, 149: 113-254), lives in salt marshes, not on sea shores, and is widespread in the deserts of southern California. It probably inhabited those areas long before the formation of the Salton Sea.

The Salton Sea was formed in 1904, when the Colorado River overflowed its banks. It is located 235 feet below sea level, in the Colorado Desert about eighty miles inland from the Pacific Ocean over a mountain range whose lowest pass is 2600 feet, and about 100 miles north of the Gulf of California. Its present salinity is slightly greater than that of sea water. The shores of the Salton Sea provide a habitat more like that of the large enbayments of southern Baja California than that of the sea beaches of southern California. The climate of Baja California is semi-desert in the northwest, becoming progressively more arid to the south until that of the middle of the peninsula is similar to the climate of the Colorado Desert except for heavy fogs along the Pacific Coast. It seems likely that *Cafius sulcicollis* (along with *C. decipiens* and *C. opacus*) is distributed along the Pacific shores of southern Baja California, and is uncommon in southern California because that region is at the northern extreme of its range.

Species of *Cafius* are known to feed at least in part on larval Diptera in decaying seaweed (James, Moore and Legner 1971, Trans. San Diego Soc. Nat. Hist., 16: 279-289). Some areas of the collection locality at Desert Beach were covered with a layer of decaying tamarisk needles containing dipterous larvae which could have provided suitable food.

How *Cafius sulcicollis* came to the Salton Sea is a matter of conjecture. This species is a strong flyer which sometimes swarms along the beaches (Leech and Moore 1971, Wasman J. Biol., 29: 65-70). Gravid females possibly could have been carried over the mountains during storms, or they might have been trailered to the Salton Sea in boats. It is unlikely that the species was introduced from the Gulf of California as no member of the genus is known from the northern part of the Gulf.—IAN MOORE AND E. F. LEGNER, *Division of Biological Control, University of California, Riverside, 92502.*

BOOK REVIEWS

THE INSECTS OF AUSTRALIA. Edited by I. M. Mackerras. Melbourne University Press. U. S. Distributor: International Scholarly Book Services, Inc. 1029 p., 704 figs., 8 color plates, Color frontice plate. 1970. \$22.50 (U.S.).

The days are past in which a single author can produce a comprehensive textbook in general entomology with an up to date coverage of the higher classification of insects to the family level for any major region. Thus the present book is a product of the efforts of 30 entomologists with diverse specialties. However, this type of approach also has its problems, especially in providing a uniform, coordinated and yet sufficiently concise treatment to fit into a single volume. The efforts of the editor, I. M. Mackerras, and of D. F. Waterhouse, Chief, Division of Entomology, CSIRO who coordinated many of the activities involved, have been highly successful in providing us with a well balanced product. Both men and all the contributors are to be congratulated for their efforts.

This tome of over 1,000 pages is extremely impressive not only in its size and weight, but in the nature and quality of its contents. The first nine chapters of about 200 pages provide a general treatment of the morphology, physiology, cytogenetics, developmental biology, natural history, phylogeny, systematics, and zoogeography of insects. The next 28 chapters of about 750 pages present the systematic treatments of each of the classes of hexapods and orders of insects.

The difficulties of one author producing a comprehensive treatment of general entomology are akin to the difficulties of one reviewer trying to evaluate the efforts of 30 authors. So I will concentrate on the broader aspects of the volume and leave the detailed criticisms of specific chapters to experts in those areas.

The first nine chapters provide an excellent coverage of the basic aspects of insect structure, function and biology. However, those interested in the applied aspects of entomology will undoubtedly be disappointed in the lack of coverage given to agricultural, medical and forest entomology and biological control. One finds only brief references to the importation of *Cactoblastis* for the control of *Opuntia* and the export of *Rodolia* to California for the control of *Icerya*, both

classical examples of biological control involving Australia. Most chapters dealing with individual orders contain at least a token section in the introduction in which the economic importance of the order is mentioned. The book is mainly directed at an audience interested in the classification and natural history of insects of the Australian region.

The introductory chapters contain much information of a type not found in other general entomological textbooks available in English. A considerable amount of biochemistry (structure and formation of the integument, hormones, metabolism, and excretion) is discussed and pathways figured in a clear manner in the chapter by D. Gilmour, *et al.* Chapters on Cytogenetics by M. J. D. White; Fossil history by E. F. Riek; and Composition and distribution of the fauna by I. M. Mackerras provide extremely useful summaries of information not readily available to the general student or specialists in other areas.

Much of the higher classification differs from that found in other recent textbooks providing us with some refreshing new views about insects and their relatives and with plenty of fuel for future polemics over our classificatory schemes. The Collembola, Diplura and Protura are not included in the Class Insecta but each is treated as a separate class in a chapter on entognathous hexapods. The ectognathous apterygotes are divided into two orders Archeognatha (Meinertellidae and Machilidae) and Thysanura (rest). Orthopteroid groups including: Blattodea, Mantodea, Grylloblattodea, Phasmatodea and Orthoptera (*sensu* Saltitoria) are each accorded ordinal rank. The Megaloptera, Raphidioptera, and Neuroptera also are treated as separate orders. On the other hand a conservative grouping is taken in the Hemiptera (Homoptera and Heteroptera) and the Phthiraptera (Mallophaga and Anoplura). Although three orders (in the sense of this volume), Grylloblattodea, Zoraptera, and Raphidioptera, do not occur in the Australian region, the first two are each discussed in brief chapters.

The systematic chapters each contain discussions of adult anatomy, immatures, biology, world classification at the family level with notations as to the occurrence and abundance of families in Australia, keys and brief discussions of each family in Australia.

This will remain one of the most valuable general references for all entomologists for some time to come. Those with a special interest in the zoogeographic relationships of the Southern Continents also will find this a basic tool in their work.—ROBBIN W. THORP, *University of California, Davis, 95616.*

AMERICAN ENTOMOLOGISTS. By Arnold Mallis. Rutgers University Press, 30 College Avenue, New Brunswick, New Jersey 08903. Pp. XVIII + 549, 211 + 8 illustrations. October, 1971. \$15.00.

Reference books tend to be dull reading, but here is one which can also be read from cover to cover or kept as a bedside companion, with equal pleasure. It is surely a labor of love—and over the years a remarkable amount of work must have gone into its preparation. As a reference it will be in constant use, yet it is equally for the reader and browser, highly recommended and a pleasure to use. It is dedicated to S. W. Frost, and to the memory of E. C. Van Dyke and J. J. Davis.

Mallis retells for us the lives of 211 entomologists. His studies are based on

published obituaries, enriched wherever possible from notes obtained by extended and widespread correspondence with "old timers." References and quotations are cited so that we may verify if we wish. But it is his ability to pick out the activities, eccentricities and sayings, which make the personalities come alive and be remembered.

Many entomologists were intentionally omitted from the present volume. In the Preface Mallis writes "I can only hope that I have used good judgment in my selection, and, where I have failed, possibly I can make amends at some future date." Students will look forward to a second volume with anticipation.

One is impressed by the number of entomologists who spent their boyhoods on farms or on acreage near a town or city, and by the number who were from, or moved to, Kansas. Many a lifelong interest was sparked by seeing another person collecting, or by the chance reading of one of the early textbooks or agricultural reports, not surprising in a period when most entertainment had to be home-produced, while books were scarce and prized. Reading the sketches, one often wishes for more about certain individuals (for instance, J. W. Folsom), yet the information may never have been published; perhaps the writers did not know the deceased intimately, or thought that the human side of a story did not belong in "serious" obituaries. It is typical of obituaries of entomologists that little credit is given to their parents, wives or husbands, who so often encouraged them in their hobby or career at the expense of needed family items and despite public opinion of mere bug chasers. Appreciation by the entomologists themselves is found in the dedications of monographs and books.

Attention may be called to one error. The Pacific Coast Entomological Society is correctly cited in places, but is also called the Pan Pacific Entomological Society (p. 169) and the Pacific Entomological Society (p. 215). H. C. Fall is stated to have been the founder of the society (p. 268), but it was first called together by Charles Fuchs; Fall acted as temporary president for that meeting of 15 August 1901, at which Fuchs was elected president of the society, then known as the California Entomological Club. But these are small points, and we are greatly indebted to Arnold Mallis for making so many entomologists live again for us.—HUGH B. LEECH, *California Academy of Sciences, San Francisco, 94118.*

MONOGRAPHIE DER FAMILIE PLATYPODIDAE COLEOPTERA. By Karl E. Schedl. Verlag Dr. W. Junk N. V., Den Haag, The Netherlands. Pp. VI + 322, 73 figs. 1972. Price 70 Dutch florins (with postage, just over \$25.00 U.S.).

The ambrosia beetles are fungus-carrying wood borers of wide distribution, especially numerous in tropical and subtropical regions. Although small they may occur in huge populations, and some are of real economic importance; a few species have spread with the aid of man's commerce. Dr. Schedl has had a lifelong interest in the systematics and bionomics of bark and ambrosia beetles, his collection contains over 80% of the recognized species of Platypodidae. The book is up to date and includes references into 1971; the lists of species, with citations, are particularly valuable because the previous world catalogue, by Strohmeyer in Junk and Schenkling's *Coleopterorum Catalogus*, dates to 1912.

The first 80 pp. include a short historical sketch on a geographic basis, and treat of the morphology and anatomy of larvae and adults, the biology in detail,

population dynamics, outbreaks, economic importance, control, and relevant literature, fossils, phylogeny, geographic distribution, and comments on errors in the literature. The remainder of the book is a taxonomic treatment of the family, with identification keys to subfamilies and genera, and in large genera to species groups; for instance there is a key of 62 couplets to the descriptively named sections (e.g., *Platypi opaci-carinati*) of the over 500 listed species of *Platypus*. The illustrations are good, some outstandingly so; there is a 44 page index. The binding is attractive, but the pages, though of good quality paper, are not sufficiently opaque, so that text and figures show through.

Despite this very fine treatment, it is clear that the last word has not been said. F. G. Brown's major paper "Larvae of the principal old world genera of the Platypodidae" (1972. *Trans. Roy. Entomol. Soc. London*, 124(2): 167-190, 54 figs.) uses a very different classification, which is based also on his extensive knowledge of the adults.—HUGH B. LEECH, *California Academy of Sciences, San Francisco, 94118*.

ESSAYS IN EVOLUTION AND GENETICS IN HONOR OF THEODOSIUS DOBZHANSKY. A Supplement to *Evolutionary Biology*. Edited by Max K. Hecht and William C. Steere. Appleton-Century-Crofts. 594 p., 70 figs., 85 tables. 1970. \$16.00.

A volume covering a wide variety of subjects dedicated to one of the most outstanding evolutionists of our time on the occasion of his seventieth birthday. The series of 16 essays written by 27 of Professor Dobzhansky's colleagues begins with a chapter on his own life summarizing his many achievements and including a bibliography of over 400 publications.

Many of the essays deal with insects, especially *Drosophila*. In Chapter 4 "Competition, Coexistence and Evolution," Francisco J. Ayala presents a theoretical discussion of these concepts and documents most of his arguments with data from populations of *Drosophila*. A considerable portion of Chapter 8 "Heterozygosity and Genetic Polymorphism in Parthenogenic Animals" by M. J. D. White deals with various parthenogenic insects. Chapter 9 "Evolutionary Studies on *Maniola jurtina* (Lepidoptera Satyridae): 'The Boundary Phenomenon' in Southern England, 1961 to 1968" by E. R. Creed, W. H. Dowdeswell, E. B. Ford and K. G. McWhirter presents a review of their published studies through 1960 and a year by year account of the shifts in the boundary between the two female wing spotting forms from 1961 through 1968. Chapters 10 through 15 deal with a variety of studies on *Drosophila* and its relatives. Chapter 10 "The Genetic Basis of a Cell-Pattern Homology in *Drosophila* Species" by T. M. and Rose M. Rizki discusses the use of a specific biochemical phenotype (kynurenine producing) of a cell to study of speciation in relation to developmental genetics of hybrids between two closely related *Drosophila*. Chapter 11 "Ecological Factors and the Variability of Gene-Pools in *Drosophila*" by John Beardmore presents evidence that habitat heterogeneity strongly influences the amount of variability in gene-pools. Chapter 12 "Mating Propensity and Its Genetic Basis in *Drosophila*" by Eliot B. Spiess points out that females do the selecting among the diversity of courtship patterns presented by the males and thus the organism plays an active role in its own selective process. Chapter 13 "Observations on the Microdispersion of *Drosophila melanogaster*" by Bruce Wallace stresses that the slight extent to which flies move

coupled with the enhanced success of chance migrants in mating fits well with the observed mating patterns, allelism, and dispersal of *D. melanogaster*. Chapter 14 "Studies on the Evolutionary Biology of Chilean Species of *Drosophila*" by Danko Brncic analyses chromosomal structure in relation to distribution patterns in space and time. Chapter 15 "The Evolutionary Biology of the Hawaiian *Drosophilidae*" by Hampton L. Carson, D. Elmo Hardy, Herman T. Spieth and Wilson S. Stone analyses what has become one of the best known complexes of drosophilids, primarily due to the efforts of these researchers.

The book is a great tribute to a great scientist and a worthy addition to an entomologist's library.—ROBBIN W. THORP, *University of California, Davis, 95616*.

INSECT PINS

\$4. / 1000 (10 Pkgs.)

(Plus Postage)

PROMPT DELIVERY

LOWEST PRICES IN AMERICA

CLAIR ARMIN
191 W. Palm Avenue
Reedley,
California 93654

ENTOMOLOGICAL EXCHANGES AND SALES

Space is available to members and non-members who wish to advertise entomological exchanges, sales, announcements, etc. We can offer an ad in four issues for \$1.50 per line. Ads will be arranged in order of their receipt. Contact the Advertising Manager, W. H. Lange, Department of Entomology, University of California, Davis, California 95616.

FOR SALE. Extensive collection of mayfly reprints. Write R. Brusca, Department of Biology, University of Arizona, Tucson, 85721.

FOR SALE. Over 900 species of butterflies from the Malaysian and Indonesian Jungles, very rare moth (14" wing span), Scorpion, giant sized Indonesian flying lizard, centipedes, stick insects, all types of rhinoceros beetles and rare beetles in the families Scarabaeidae, Lucanidae, Mordellidae, Cerambycidae, etc. Write Sim Yam Seng, 21, Joon Hiang Road, Singapore, 19, Singapore.

COMMERCIAL AND RESEARCH ENTOMOLOGISTS

Obtain more accurate population counts
with a light-weight motor-fan unit
which sucks insects into nets

D-VAC
MOTOR-FAN VACUUM INSECT NETS
BACK-PACKS AND HAND MODELS

-also-

BENEFICIAL INSECTS
INSECTARY GROWN AND FIELD COLLECTED
Trichogramma sp. and Green Lacewings

Write for Brochures

D-VAC CO.
P. O. Box 2095
RIVERSIDE, CALIFORNIA

THE MOTHS OF AMERICA NORTH OF MEXICO

THE MOTHS OF AMERICA, one of the most significant publications in the history of American entomology, will contain full-color photographs of all 10,000+ species of North American moths. The color photography has been done with excruciating care and attention to detail, and must be seen to be believed.

THE MOTHS OF AMERICA, written by authorities in each group treated, constitutes a thorough review of the North American moths, with descriptions of new genera and species where appropriate.

In addition to the color photographs of adults, illustrations of genitalia or other structures are included where necessary to assure accurate identification. The comprehensive text gives a full taxonomic treatment, including synonymy, plus information on distribution, foodplants, biology, and other aspects of each species.

THE MOTHS OF AMERICA will be published in over 100 parts, over a period of about 20 years. Each part is individually priced, according to its size, number of color plates, and number of copies printed. Three to five parts are expected each year.

Special pre-publication/subscription prices, about 20% less than the regular list prices, apply to subscriptions for the entire work and to orders received prior to the publication of specific parts. (NOTE: The only way to get the parts already published at the reduced prices is to subscribe to the entire series.)

Please start your subscription now, or order the parts you desire, before the cost becomes prohibitive.

ALREADY PUBLISHED:

Fascicle 13, Part 1a, Pyralidae: Scopariinae & Nymphulinae, by Dr. Eugene G. Munroe. 1972. 134 p. \$20.60 (\$16.50 to subscribers).

Fascicle 13, Part 1b, Pyralidae: Odontiinae & Glaphyriinae, by Dr. Eugene G. Munroe. 1972. 116 p. \$20.60 (\$16.50 to subscribers).

Fascicle 20, Part 2a, Bombycoidea: Saturniidae, in part (Citheroniinae and Hemileucinae, in part), by Dr. Douglas C. Ferguson. 1972. 153 p., 11 color plates, 19 figs. \$39.00 (\$32.50 to subscribers).

Fascicle 20, Part 2b, Bombycoidea: Saturniidae, in part (Hemileucinae, in part, and Saturniinae), by Dr. Douglas C. Ferguson. 1972. xxi + 121 p., 11 color plates, 11 figs. \$39.00 (\$32.50 to subscribers).

Fascicle 21, Sphingoidea, by Dr. Ronald W. Hodges. 1971. xii + 158 p., 16 plates (14 in color), 8 halftones, 19 figs. \$24.00 (\$19.60 to subscribers).

IN PREPARATION:

Fascicle 20, Part 1, Bombycoidea (excluding Saturniidae) (i.e., Lasiocampidae, Mimallonidae, Apetelodidae, and Bombycidae), by Dr. J. G. Franclemont.

Fascicle 13, Part 1c, Pyralidae: Evergestiinae, by Dr. Eugene G. Munroe (including 14 color plates for all 3 parts of Fascicle 13. 1).

Fascicle 6, Part 2, Gelechioidea: Oecophoridae, by Dr. Ronald W. Hodges.

Fascicle 22, Part 2, Lymantriidae, by Dr. Douglas C. Ferguson.

Also in preparation: Notodontidae, Cosmopterygidae, Walshiiidae, and Aegeriidae.

THE MOTHS OF AMERICA NORTH OF MEXICO belongs on the shelf of every serious lepidopterist and in every significant library. Please make sure that your local library subscribes, so that this important reference work will be available to you and your colleagues in the future.

A fully descriptive brochure, with sample color plate and order form, is available on request.

THE MOTHS OF AMERICA NORTH OF MEXICO is distributed exclusively in North America by:



Entomological Reprint Specialists

P.O. Box 77224, Dockweiler Station, Los Angeles, California 90007, U.S.A.

Entomological Reprint Specialists sells any insect book in print. Please write for price lists or quotations.

THE PAN-PACIFIC ENTOMOLOGIST

Information for Contributors

Papers on the systematic and biological phases of entomology are favored, including articles up to *ten* printed pages on insect taxonomy, morphology, behavior, life history, and distribution. Excess pagination must be approved and may be charged to the author. Papers are published in approximately the order that they are received. Immediate publication may be arranged *after* acceptance by paying publication costs. Papers of less than a printed page may be published as space is available, in SCIENTIFIC NOTES.

Manuscripts for publication, proof, and all editorial matters should be addressed to the Editor, John T. Doyen, Division of Entomology & Parasitology, University of California, Berkeley, California 94720.

Typing.—All parts of manuscripts must be typed on bond paper with double-spacing and ample margins. Carbon copies or copies on paper larger than $8\frac{1}{2} \times 11$ inches are not accepted. Do not use all capitals for any purpose. Underscore only where italics are intended in the body of the text, not in headings. Number all pages consecutively and put author's name at the top right-hand corner of each sheet. References to footnotes in text should be numbered consecutively. Footnotes should be typed on a separate sheet.

First page.—The page preceding the text of the manuscript should include (1) the complete title, (2) the order and family in parentheses, (3) the author's name or names, (4) the institution with city and state or the author's home city and state if not affiliated, (5) the shortened title (running headline) not to exceed 38 letters and spaces when combined with the author's last name or names, (6) the complete name and address to which proof is to be sent.

Names and descriptions of organisms.—The first mention of a plant or animal should include the full scientific name with the author of a zoological name *not* abbreviated. Do not abbreviate generic names. Descriptions of taxa should be in telegraphic style.

References.—All citations in text, e.g., Essig (1926) or (Essig, 1958), should be listed alphabetically under LITERATURE CITED in the following format:

Essig, E. O. 1926. A butterfly migration. *Pan-Pac. Entomol.*,
2: 211-212.

1958. *Insects and mites of western North America*. Rev.
ed. The Macmillan Co., New York. 1050 pp.

Abbreviations for titles of journals should follow the list of *Biological Abstracts*, 1966, 47(21) : 8585-8601.

Tables.—Tables are expensive and should be kept to a minimum. Each table should be prepared as a line drawing *or* typed on a separate page with heading at top and footnotes below. Number tables with Arabic numerals. Number footnotes consecutively for each table. Use only horizontal rules.

Illustrations.—No extra charge is made for the line drawings or halftones. Submit only photographs on glossy paper and original drawings (no photographs of drawings). Authors *must* plan their illustrations for reduction to the dimensions of the printed page ($4\frac{1}{8} \times 6\frac{3}{4}$ inches). If possible, allowance should be made for the legend to be placed beneath the illustration. Photographs should not be less than the width of the printed page. Drawings should be in India Ink and at least twice as large as the printed illustration. Excessively large illustrations are awkward to handle and may be damaged in transit. Include a metric scale on the drawing or state magnification of the *printed* illustration in the legend. Arrange figures to use space efficiently. Lettering should reduce to no less than 1 mm. *On the back of each illustration* should be stated (1) the title of the paper, (2) the author's complete name and address, and (3) whether he wishes the illustration and/or cut returned to him *at his expense*. Cuts and illustrations not specifically requested will be destroyed.

Figure legends.—Legends should be typewritten double-spaced on separate pages headed EXPLANATION OF FIGURES and placed following LITERATURE CITED. Do not attach legends to illustrations.

Proofs, reprints, and abstract.—Proofs and forms for the abstract and reprint order will be sent to authors. Major changes in proof will be charged to the author. Proof returned to the editor without the abstract will not be published.

Page charges.—All regular papers of one to ten printed pages are charged at the rate of \$18.00 per page. This is in addition to the charge for reprints and does not include the possible charges for extra pagination or the costs for immediate publication. Private investigators or authors without institutional or grant funds to cover this charge may apply to the Society for a grant to cover the page charges. A mark in the appropriate box (society grant desired) on the reprint order form will suffice as an application.

All articles are accepted for publication *only* on the basis of scientific merit and without regard to the financial support of the author.

**PUBLICATIONS
OF THE
PACIFIC COAST ENTOMOLOGICAL SOCIETY**

PROCEEDINGS OF THE PACIFIC COAST ENTOMOLOGICAL SOCIETY.

Vol. 1 (16 numbers, 179 pages) and Vol. 2 (numbers 1-9, 131 pages). 1901-1930. Price \$2.50 per volume.

PAN-PACIFIC ENTOMOLOGIST.

Vol. 1 (1924) to present. Price \$10.00 per volume of 4 numbers, or \$2.50 per single issue.

MEMOIR SERIES.

Volume 1. *The Sucking Lice* by G. F. Ferris. A 320-page book which summarizes the knowledge of the Anoplura of the world. Published October 1951. Price \$6.00. (Plus 35¢ postage.)*

Volume 2. *The Spider Mite Family Tetranychidae* by A. Earl Pritchard and Edward W. Baker. This worldwide treatment deals with the systematics, identification, and economics of the "Red Spiders" and includes descriptions of 33 new species. 472 pages. Published July 1955. Price \$10.00. (Plus 50¢ postage.)*

Volume 3. *Revisionary Studies in the Nearctic Decticinae* by David C. Rentz and James D. Birchim. This 173-page revision of Nearctic shield-back katydids includes descriptions of one new genus and 13 new species and subspecies. Published July 1968. Price \$4.00. (Plus 25¢ postage.)*

Volume 4. *Autobiography of an Entomologist* by Robert L. Usinger. A 343 page book relating the life story of one of the outstanding entomologists of our time. Published August 1972. Price \$15.00. (Plus 40¢ postage.)*

* (Add 5% sales tax on all California orders. Members of the Society will receive a 20% discount.)

Send orders to:

Pacific Coast Entomological Society
c/o California Academy of Sciences
Golden Gate Park
San Francisco, California 94118

THE PAN-PACIFIC ENTOMOLOGIST



MAYO—A new species of <i>Baetis</i> from Ecuador (Ephemeroptera: Baetidae) ..	285
SHAPIRO—Recurrent aberration in <i>Cynthia annabella</i> ; A review with four new records (Lepidoptera: Nymphalidae)	289
PARKER AND POTTER—Biological notes on <i>Lithurgus apicalis</i> Cresson (Hymenoptera: Megachilidae)	294
McCAFFERTY AND EDMUNDS—Subgeneric classification of <i>Ephemer</i> (Ephemeroptera: Ephemeridae)	300
MAYO—Four new species of the genus <i>Baetodes</i> (Ephemeroptera: Baetidae)	308
NELSON—Synopsis of the genus <i>Chilenoperla</i> (Plecoptera: Gripopterygidae)	315
WASBAUER—Some new taxa in the Myrmosinae with keys to the females of North America (Hymenoptera: Tiphidae)	325
CHEMSAK AND LINSLEY—New species of <i>Eburia</i> from Mexico (Coleoptera: Cerambycidae)	338
GRISSELL—New species of <i>Eurytoma</i> associated with Cynipidae (Hymenoptera: Eurytomidae)	354
ALLEN—New species of <i>Leptohyphes</i> Eaton (Ephemeroptera: Tricorythidae)	363
MATHIS—A review of the genus <i>Borboropsis</i> (Diptera: Heleomyzidae) ..	373
CHANDLER—The <i>Hamotus</i> of Arizona (Coleoptera: Pselaphidae)	378
DALY—Lectotype designations of African bees of the genus <i>Ceratina</i> and allies (Hymenoptera, Apoidea)	383
CHRISTIANSEN AND BELLINGER—Six new Nearctic species of the genus <i>Friesea</i> (Collembola: Poduromorpha)	389
WHEELER AND WHEELER—Ant larvae of the subfamily Dolichoderinae: second supplement (Hymenoptera: Formicidae)	396
SCIENTIFIC NOTES	288, 324, 337, 353, 377, 395, 402, 403
BOOK REVIEW	299
BOOK NOTICE	372
RECENT LITERATURE	388
ZOOLOGICAL NOMENCLATURE	404
INDEX TO VOLUME 49	405

SAN FRANCISCO, CALIFORNIA • 1973

Published by the PACIFIC COAST ENTOMOLOGICAL SOCIETY
in cooperation with THE CALIFORNIA ACADEMY OF SCIENCES

THE PAN-PACIFIC ENTOMOLOGIST

EDITORIAL BOARD

J. T. DOYEN, *Editor*

J. A. CHEMSAK, *Asst. Editor*

E. G. LINSLEY

H. V. DALY

P. H. ARNAUD, JR., *Treasurer*

E. S. ROSS

H. B. LEECH

Published quarterly in January, April, July, and October with Society Proceedings appearing in the January number. All communications regarding nonreceipt of numbers, requests for sample copies, and financial communications should be addressed to the Treasurer, Dr. Paul H. Arnaud, Jr., California Academy of Sciences, Golden Gate Park, San Francisco, California 94118.

Application for membership in the Society and changes of address should be addressed to the Secretary, Mr. Michael R. Gardner, 131 Aspen Drive, Pachecho, California 94553.

The annual dues, paid in advance, are \$7.50 for regular members of the Society, \$5.00 for student members, or \$10.00 for subscriptions only. Single copies are \$2.50 each or \$10.00 a volume. Make checks payable to *Pan-Pacific Entomologist*.

The Pacific Coast Entomological Society

OFFICERS FOR 1973

J. A. CHEMSAK, *President*

PAUL H. ARNAUD, JR., *Treasurer*

C. B. PHILIP, *President-elect*

MICHAEL R. GARDNER, *Secretary*

STATEMENT OF OWNERSHIP

Title of Publication: The Pan-Pacific Entomologist.

Frequency of Issue: Quarterly (January, April, July, October).

Location of Office of Publication, Business Office of Publisher, Publisher and Owner: Pacific Coast Entomological Society, California Academy of Sciences, Golden Gate Park, San Francisco, California 94118.

Editor: Dr. John T. Doyen, Division of Entomology & Parasitology, University of California, Berkeley, California 94720.

Managing Editor and Known Bondholders or other Security Holders: None.

This issue mailed 16 April 1974

Second Class Postage Paid at San Francisco, California and additional offices.

ALLEN PRESS, INC.

PRINTED
IN
U.S.A.

LAWRENCE, KANSAS

The Pan-Pacific Entomologist

VOL. 49

OCTOBER 1973

No. 4

A New Species of *Baetis* From Ecuador

(Ephemeroptera: Baetidae)

VELMA KNOX MAYO

2702 E. Seneca St., Tucson, Arizona, 85716

Baetis ellenae Mayo is one of a group of large species that occurs from Mexico to Peru. When mature, nymphs characteristically climb out of the water onto rocks or logs wet by spray.

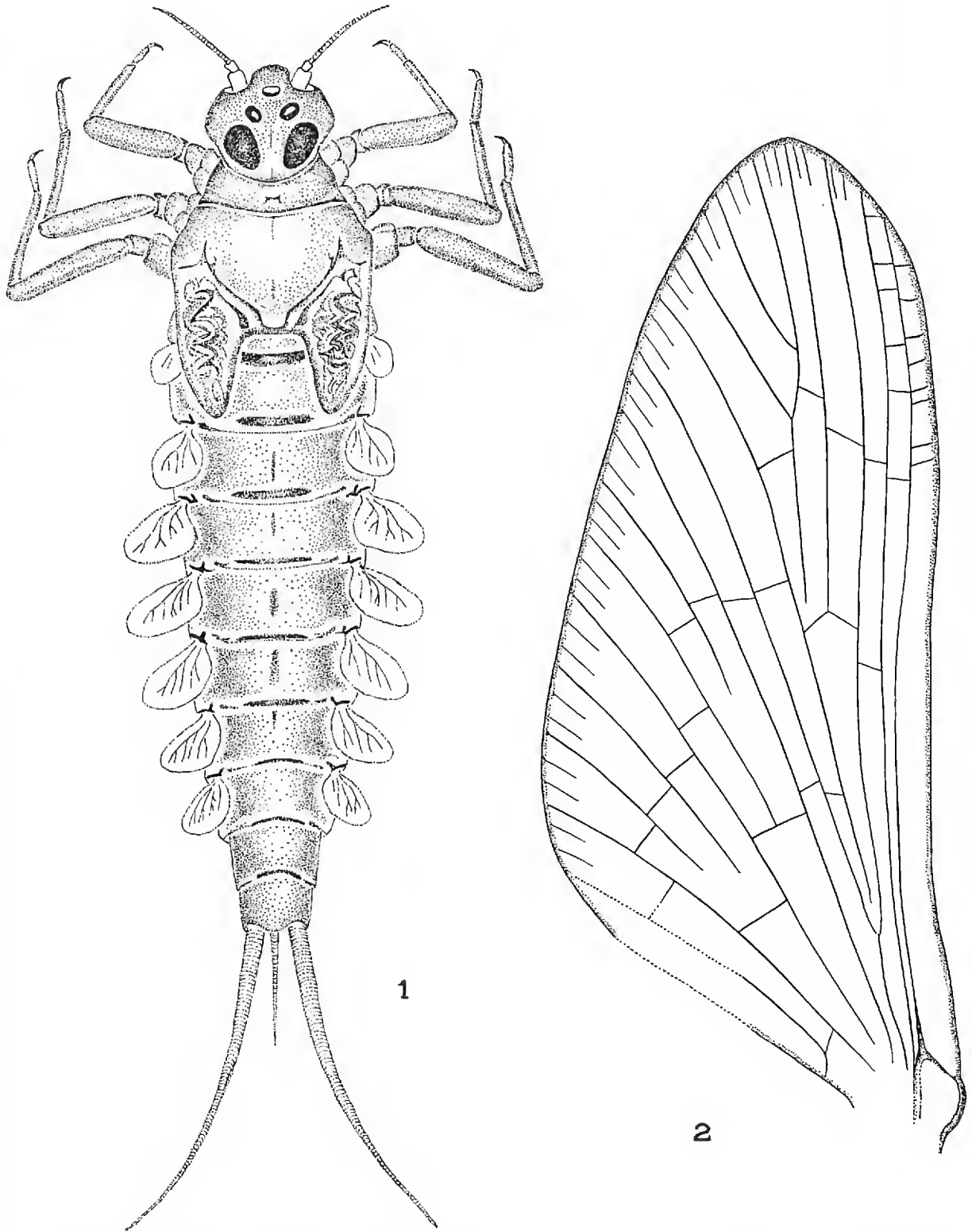
Baetis ellenae Mayo, new species

(Figs. 2, 3, 6)

MALE IMAGO.—Length: body 10 mm; fore wing 10 mm; caudal filaments 26 mm; body color yellow with rust markings. Head bright yellow; bases of antennae yellow, bordered with brown distally; distal segments dark smoky or black; median carina with a blackish brown band; eyes turbinate, orange-red, oval and moderately convex. Thorax bright yellow; mesonotum olive tinged with rust colored speckles near wing bases; metanotum yellow, postscutellum bright rust; pleural sclerites yellow, reddish near coxae, on posterior portion of episternum and on pleural trochantin; fore wing amber tinged, veins distinctly reddish, marginal intercalaries paired (Fig. 2); hind wings margined with reddish-brown and with heavier reddish-brown border from base to costal projection (Fig. 3); hind wings with only two longitudinal veins; legs yellow to orange with rust and blackish brown markings; fore coxae yellow with rust streaks; trochanters tinged with rust; fore femora bright orange tinged with blackish brown apically; tibiae slightly longer than femora, yellow with blackish brown apex; tarsi slightly shorter than tibiae, yellow, brown at joints; fourth tarsomere and claw smoky; middle and hind legs yellow, penciled with black on posterior and anterior margins; femora yellow, penciled with black distally; tarsi yellow, narrowly margined with red; fourth tarsal segment and claw smoky. Abdominal terga bright yellow with blackish-brown posterior borders on either side of midline and laterally near pleural fold, borders wider on tergum 1. Genital forceps as in fig. 6. Caudal filaments pale yellow with reddish-brown joints.

FEMALE IMAGO.—Length: body 8 mm; fore wing: 10 mm. Thorax reddish olive-brown; parapsidal grooves yellow. Abdominal terga reddish brown, posterior borders dark brown; abdominal sterna yellow with reddish ganglionic markings.

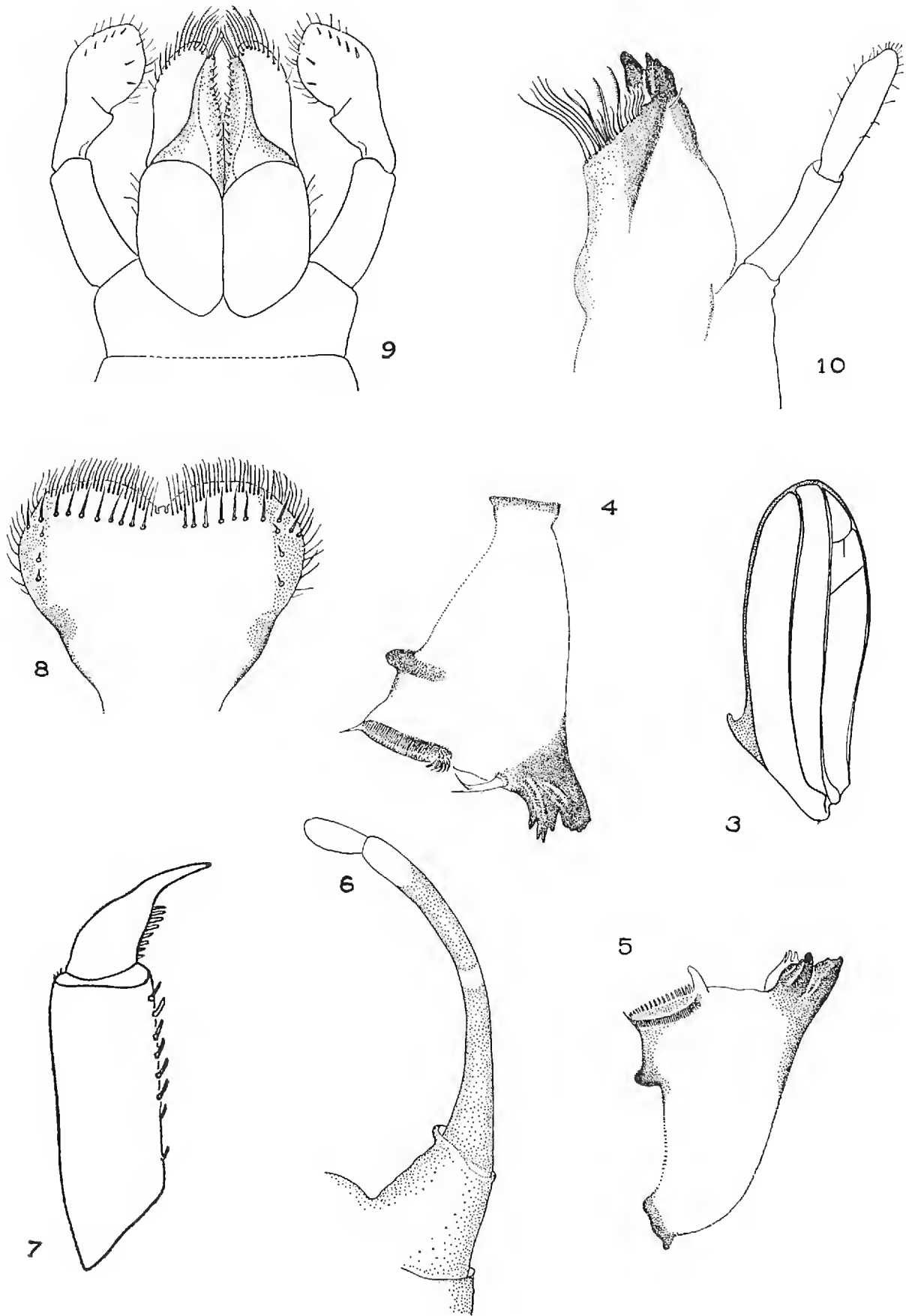
NYMPH: figs. 1, 4, 5, 7-10.—Length: body 11-13 mm; caudal filaments 7.5-8.5 mm; body color pale amber. Head pale amber; antennae pale yellow, first segment large; mouthparts as in figs. 4, 5, 8-10. Thorax amber; legs pale yellow; femora reddish brown at apices and along margins, with short spinules on dorsal crests; tibiae with short spines at apices; tarsal claws with 8 denticles (fig. 7).



FIGS. 1-2. *Baetis ellenae* Mayo. Fig. 1. Dorsal view of nymph. Fig. 2. Fore wing of imago.

Posterior borders abdominal terga amber with dark reddish brown medially and mesad to gills (fig. 1); terga 3-7 with reddish-brown streaks along midline in some specimens; gill trachea pale to dark reddish brown; abdominal sterna and caudal filaments amber.

HOLOTYPE MALE IMAGO, RIO AMAYO, MACUCHI, COTOPAXI PROVINCE, ECUADOR; altitude about 6000 ft., V. K. Mayo, 30 June 1943. Entomological collection, University of Utah, Salt Lake City. Female and 1 paratype imago, same data, same deposition as holotype. Paratypes: 4 nymphs, same data, 7 July 1942; 1 nymph



FIGS. 3-10. *Baetis ellenae* Mayo, various structures of nymph and imago. Fig. 3. Hind wing of imago. Figs. 4-5. Right and left mandible, respectively, of nymph. Fig. 6. Right forceps of adult male. Fig. 7. Tarsus and claw of nymph. Figs. 8-10. Labrum, labium and maxilla, respectively, of nymph.

same data, 22 November, 1942; 4 nymphs same data, 6 March 1943; 16 nymphs near Pilalo Road at 5 Km., 7 March 1943. 12 nymphs same data, 30 June 1943. All nymphs same deposition as holotype. Nymphs and adults were associated by rearing.

The nymphs of *B. ellenae* are the most common species of the genus in the Macuchi region. Mature specimens commonly climb out of the water onto a log or rock where the spray wets them. The only other nymph described in the group with similar habits was designated *Baetis* sp. 1 by Roback (1966). Nymphs of the two species are of the same size but differ in coloration. *B. ellenae* is pale amber, while *Baetis* sp. 1 is brown. The two species also differ in details of the mouthparts (fig. 4, 5, 8, 10) and figs. 77, 80–83 (Roback 1966). This species is named in honor of the writer's daughter, Ellen Mayo Harbert.

The writer wishes to acknowledge the help of Jay R. Traver, Massachusetts University, Amherst, Massachusetts who read the manuscript. She is also indebted to Richard K. Allen of California State University at Los Angeles for help in editing the manuscript, and to W. L. Peters, Florida A. and M. University, Tallahassee, who contributed valuable suggestions.

LITERATURE CITED

- ROBACK, S. S. 1966. Catherwood Foundation Peruvian-Amazon Expedition, VI. Ephemeroptera nymphs. Monogr. Acad. Sci. Phila., 14: 129–199, 22 pl.

SCIENTIFIC NOTE

New Records for Georyssidae and Cyathoceridae (Coleoptera) in Mexico.—When collecting in Sonora on November 31, 1972 at the Arroyo Cuyuchaba, 11.5 miles west of Alamos, Karl Stephan and I picked up three species of two lesser known families of Coleoptera, the Georyssidae and Cyathoceridae (= Lepiceridae). The species collected were *Georyssus minor* Sharp (3 individuals), *Cyathocerus horni* Sharp (2 individuals) and *Cyathocerus bufo* Hinton (2 individuals). The specimens were identified by comparison with Hinton's descriptions of the three species (1933, Pan-Pac. Entomol. 9: 160–162).

The beetles were obtained by placing river drift, which had been deposited on the banks of the arroyo after two days of heavy rain, in a pan of water and then collecting the struggling Coleoptera. The cyathocerids and georyssids were observed when they were climbing through the debris just under the surface of the water. They did not attempt to climb on top of the floating debris as did the other Coleoptera in the pan. Hinton obtained his larger series of the species from an identical habitat, damp trash piles left by a river just west of Mexico City at Tejupilco.

Hinton's collection of the three species were the northernmost records for the two sharp species (*C. bufo* is known only from its type locality of Tejupilco). The records from Alamos extend their range approximately 700 miles, to the northern edge of the thorn forest in Sonora.—DONALD S. CHANDLER, *University of Arizona, Tucson 84721.*

Recurrent Aberration in *Cynthia annabella*
A Review with Four New Records

(Lepidoptera: Nymphalidae)

ARTHUR M. SHAPIRO

Department of Zoology, University of California, Davis, 95616

Three species of Painted Lady butterflies occur in California: *Cynthia annabella* Field = *C. carye* of authors, *C. cardui* Linnaeus, and *C. virginensis* Drury. All produce aberrant phenotypes characterized by suppression of the discal wing pattern, fusion of the subapical dark pattern elements, and development of a series of white submarginal spots. These phenotypes were named in all three species, mostly in the heyday of aberration naming in the first three decades of this century. They attracted a great deal of attention because of their remarkable similarity in the three related species and because they occurred with exceptional frequency considering their drastic nature. When Grinnell described "*Vanessa caryae* (sic!) var. *intermedia*" and "var. *letcheri*" (Grinnell, 1918) he had before him three and nine specimens respectively, in addition to four of the similar "var. *muelleri*"—all but three northern California, and all collected between 1911 and 1917.

The record of these and similar aberrations in the literature is extensive, and may be traced in the bibliographies given by Field (1971) under the following names; in *C. cardui*: *elymi* Rambur, *emielymi* Verity, *hemielymi* Gaede; in *C. virginensis*: *ahwashtee* Fox; in *C. annabella*: *muelleri* Letcher, *intermedia* Grinnell, *letcheri* Grinnell, *schraderi* Gunder. The oldest records are of *C. cardui* "aberration *elymi*," which has been known since the early nineteenth century and was figured clearly from England by Newman (1874). In *C. annabella* this type of variation was first described by Letcher (1898) ("var. *muelleri*"). Subsequently Grinnell (1918) named "var. *intermedia*" and "var. *letcheri*," less and more extreme manifestations of the same tendency, and Gunder (1929) named yet another member of the series "transition form *schraderi*." All of these are infrasubspecific names and have no standing in formal zoological nomenclature. They were, however, extensively discussed and numerous specimens were figured by Gunder (1925, 1927a, 1927b, 1929) and Comstock (1927). Most published records—about 35—date from this period. The unsavory reputation of aberration naming led to a decline in published records. One recent record is by Phillips (1971) of a "*muelleri*" from Salt Lake City, Utah,



a



c



b



d

1



a



c



b



d

2

near the eastern edge of the range of *C. annabella*. There is no evidence that the actual incidence of these phenotypes has decreased—only the level of interest in them. They are, however, no better understood today than forty years ago.

Speculation on their evolutionary significance diverged. Grinnell was of the opinion that they had arisen in *C. annabella* quite recently and were increasing in frequency in the species. He interpreted their occurrence in the three species as an example of orthogenesis. Gunder and Comstock, conversely, interpreted it as a primitive trait derived from a common ancestor—a case of reversion or “atavism.” The extreme similarity of the phenotypes leaves little doubt that they are homologous in origin, but whether they are parallel developments or persistent from a common ancestor remains unknown. No living species of *Cynthia* or its near relatives has a normal pattern anything like that of any of them.

Dimock (1968) reported the induction of “*elymi*” in *C. cardui* by chilling fresh pupae for 14 days at 36° F. As Grinnell noted, however, the aberrant phenotypes have been taken in the summer months when chilling to the requisite degree would be very unlikely in the collection localities. Either Dimock’s specimens are phenocopies and the wild ones are produced genetically without the intervention of an abnormal environment, or else the phenotypes can be produced by more than one kind of stress. The largest number of captures in *C. annabella* is in September and October, but there are records for every month but January, March, April, and December.

I have taken three fresh aberrant *C. annabella* in the Sacramento Valley in nine months, the first such cluster of captures reported in some forty years. The records are: Willow Slough, 2.5 miles NE Davis, Yolo County v-10-72 (figs. 1a, 2a); Putah Creek Recreation Area, 3 miles SW Davis, Yolo County xi-17-72 (figs. 1b, 2b); American River basin, North Sacramento, Sacramento County ii-18-73 (figs. 1c, 2c). In addition, another specimen of slightly less aberrant phenotype was taken at Suisun City, Solano County on v-19-72 (figs. 3a, b). The pattern shown by this individual, while clearly related to the others, is unlike

←

FIGS. 1–2. *Cynthia annabella* aberrations discussed in text. Fig. 1. Dorsal surfaces: a, Yolo County, California, v-10-1972; b, Yolo County, xi-17-1972; c, Sacramento County, ii-19-1972; d, slightly aberrant individual, Yolo County, iii-7-1973. Fig. 2. Ventral surface of above specimens.



FIG. 3. Dorsal and ventral surfaces of slightly aberrant individual, Suisun City, Solano County, v-19-1973.

any specimen previously figured. These were among about 3800 wild *C. annabella* examined for beak marks during this period in the course of a predation-frequency study. The only other specimen showing the slightest variation in this direction is shown in figures 1d and 2d. It was taken at Putah Creek on iii-7-73, fresh from the pupa, and shows a very minor reduction of the discal markings on the forewings. About 100 other individuals of fresh *C. annabella* were examined in January, February, and early March after the very cold 1972-73 winter, but none was abnormal.

Postulating that the aberrant phenotypes of *C. annabella* are produced by a single recessive allele whose genotypic frequencies follow the Hardy-Weinberg law, the homozygote frequency would be 0.001 and the gene frequency 0.032. About six per cent of the hypothetical population would be heterozygous carriers. Such frequencies could not be maintained by mutation alone and would have to be considered a polymorphism. If the mutant allele were dominant, the Hardy-Weinberg law would give a gene frequency of 5×10^{-4} , a figure within the range of reasonable mutation rates. If dominance is an evolved characteristic, as is generally believed, then if the aberrant phenotypes of *C. annabella* and its relatives were due to a dominant, recurrent mutation this would be strong evidence for the "atavism" interpretation—reflecting the persistence of previously selected dominance modifiers, a condition called by E. B. Ford and his colleagues "paleogenic."

LITERATURE CITED

- COMSTOCK, J. A. 1927. Butterflies of California. Author, Los Angeles. 334 p.
 DIMOCK, T. 1968. An extreme experimental aberration of *Vanessa cardui* (Nymphalidae). J. Lepid. Soc. 22: 146.

- FIELD, W. D. 1971. Butterflies of the genus *Vanessa* and of the resurrected genera *Bassaris* and *Cynthia* (Lepidoptera:Nymphalidae). *Smithson. Contrib. Zool.* 84: 1-105.
- GRINNELL, F., JR. 1918. Some variations in the genus *Vanessa* (*Pyrameis*). *Psyche* 25: 110-115.
- GUNDER, J. 1925. Several new aberrant Lepidoptera. *Entomol. News* 36: 193-200.
- 1927a. New transition forms or "abs" and their classification (Lepid., Rhopalocera). *Entomol. News* 38: 129-138.
- 1927b. Transition forms (Lepid., Rhopalocera). *Entomol. News* 38: 263-271.
1929. An addition to *Cynthia carye* Hubner (Lepidoptera, Nymphalidae). *Pan-Pac. Entomol.* 6: 9.
- LETCHER, B. 1898. Variation of *Pyrameis carye* Hubner. *Entomol. News* 9: 38.
- NEWMAN, E. 1874. *An Illustrated Natural History of British Butterflies and Moths.* David Bogue, London. 486 pp.
- PHILLIPS, W. L. 1971. Rare aberrant forms of Utah *Cynthia*, the Painted Lady (Lepidoptera: Nymphalidae). *Great Basin Natur.* 31: 256-260.

Biological Notes on *Lithurgus apicalis* Cresson

(Hymenoptera: Megachilidae)

F. D. PARKER AND H. W. POTTER

Bee Biology and Systematics Laboratory, Agr. Res. Ser., Logan, Utah 84322

The tribe Lithurgini contains only the genus *Lithurgus* Latreille, a group that is considered to be among the least specialized of the Megachilidae (Mitchell, 1962). Nothing has been published concerning the biologies of the North American species except for floral records (Michener, 1951), though one species, *L. apicalis* Cresson, has been pestiferous in constructing its nests in the doorways of homes in Arizona (G. E. Bohart, personal communication). During June 1972, several females of this species were observed entering holes in a cottonwood log near Myton, Utah. In September of that year, pieces of the log containing nests were collected and studied.

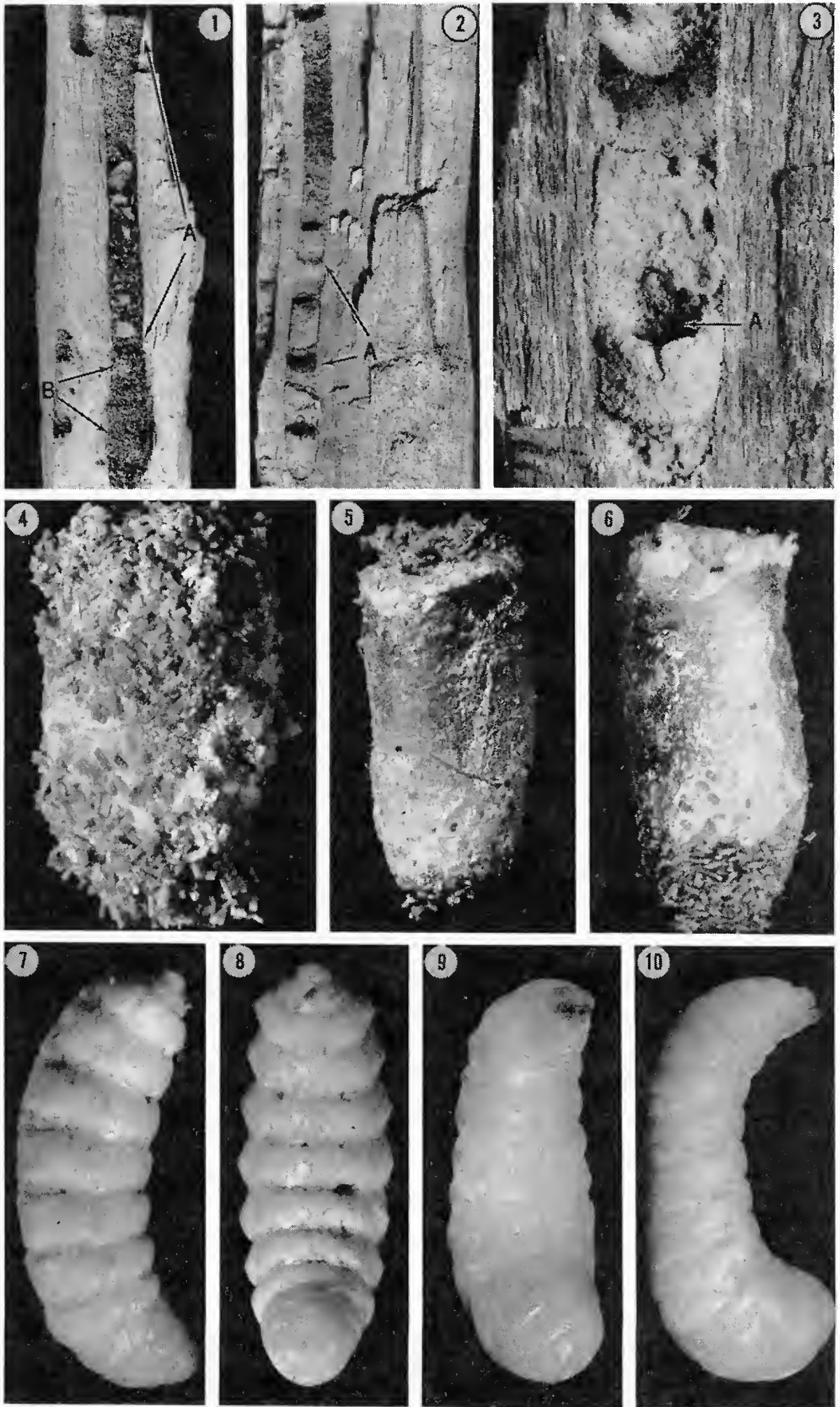
BIOLOGY

NESTING SITE.—Ten miles NW Myton, Duchesne County, Utah, in a weathered, barkless cottonwood log (foundation of an abandoned potato cellar). The log was oriented east-west, and the bees were entering holes in the west end.

NEST CONSTRUCTION.—The log in which *Lithurgus* was nesting was riddled with fingerlike tunnels, but we could not determine whether the bees had excavated their own burrows. European species of this genus are reported to gnaw out their tunnels in rotted wood (Malyshev, 1936), and Torchio (personal communication) has observed *L. echinocacti* (Cockerell) nesting in rotted wood in Arizona. In extracting the nests from the logs, most were extensively damaged, but five completed nests were located and extracted from lateral galleries leading off an en-

→

FIGS. 1-10. Figs. 1-3. Nests of *L. apicalis*: (1) nest with 2 cells. a) entrance plug (note leaf pieces and other debris), b) cocoons. (2) three-celled nest with pollen provisions. A) indicates cell partitions. (3) Enlarged view of bottom cell in fig. 2. A) indicates egg chamber. Figs. 4-6. Cocoons of *L. apicalis*: (4) Cocoon with fecal pellets covering outer surface. (5) Cocoon with anteriorly placed pellets. (6) Cocoon with posteriorly placed pellets. Figs. 7-8. Prepupae of bombyliid parasite, *Anthrax cintalapa*: (7) Lateral. (8) Ventral. Figs. 9-10. Prepupa of *L. apicalis*: (9) Ventral. (10) Lateral.



larged tunneled-out area. The tunnels ranged from 5.3 to 8.9 cm long and 6 to 7 mm in diameter.

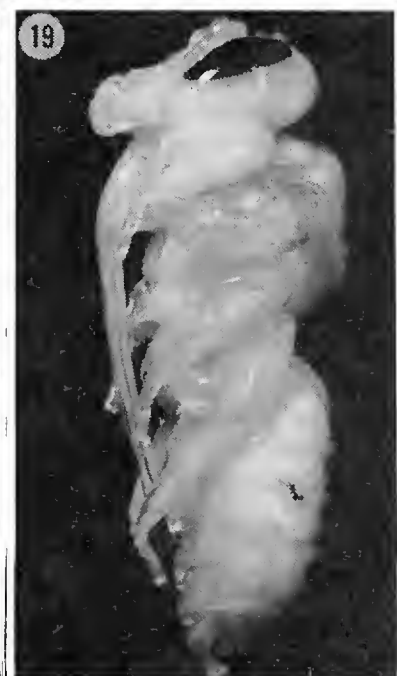
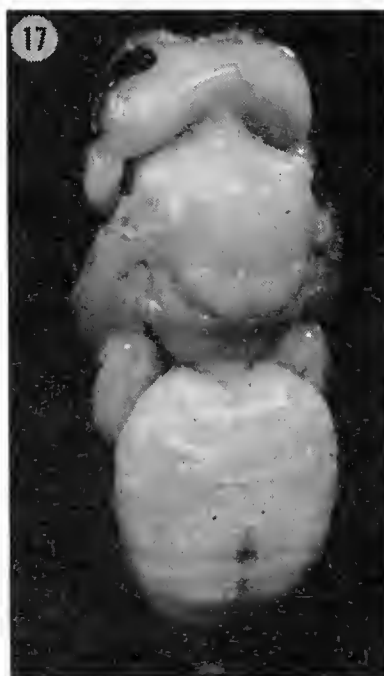
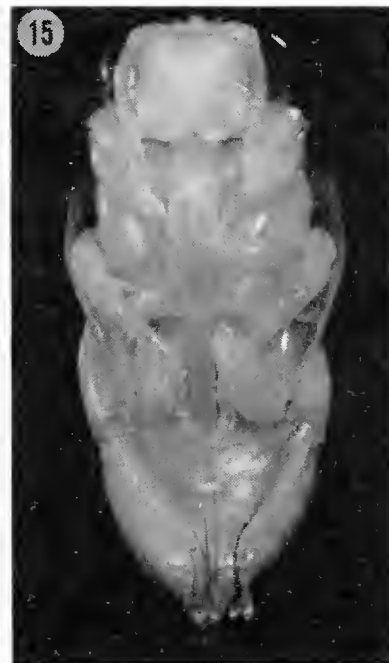
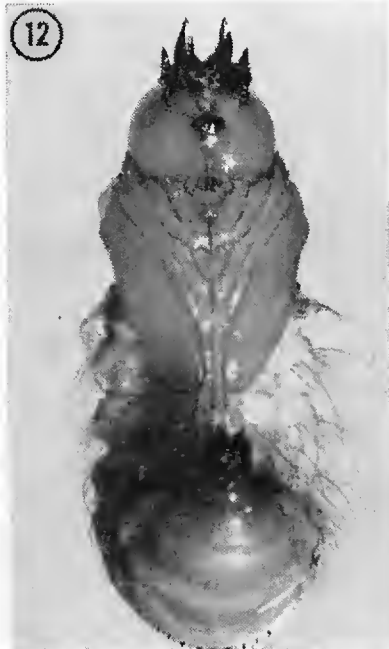
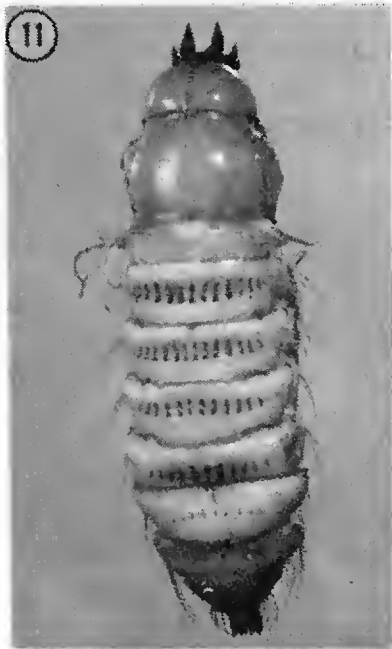
The bees had initiated cell series in both clean (new?) and old tunnels (with debris at the end) by packing pollen tightly against the basal end of the burrow and constructing a partition on top of the packed provisions. (The pollen adhered to the partitions, Fig. 3.) In multi-celled nests, the cells were placed end to end and were separated by partitions that served both as cell bases and caps. Each cell was packed with pollen from partition to partition.

The cell partitions were made primarily from scrapings of wood fibers, but they also included debris from old *Lithurgus* nests. The material for the partitions was packed into shallow saucer-shaped discs ranging in thickness from 2 to 6 mm and thinly coated above with nectar. This material readily dissolved in water. The entrance plugs, 1.3 to 6.3 cm long, were composed mostly of debris such as wood fibers, feces, pieces of cocoons, parts of bees, and pollen. Several nests had pieces of leaves incorporated into the entrance plug (Fig. 1) but these undoubtedly came from old nests of *Megachile pacifica* (Panzer) [= *M. rotundata* authors] since cells of this leafcutter were found in other galleries, and females were observed entering the holes actively used by *Lithurgus*. No vestibular cell was made, and the entrance plug was constructed directly above the last cell by filling the tunnel with tightly packed debris (Fig. 1) and by varnishing the entrance with a thin coating that appeared to be nectar. In vertical nests, the entrance plug was horizontal across the burrow, but in obliquely-oriented tunnels, the plugs were slanted.

NEST PROVISIONS.—The provisions were exclusively *Opuntia* pollen, which was tightly packed into the cells with little or no nectar. The pollen grains were easily dislodged from the cells. An egg chamber was made in the middle of the provision. We were unable to find an undisturbed egg chamber; but in one cell, a young larva had died shortly after hatching and this chamber measured 3 × 3 mm and was cup-shaped (Fig. 3). An old world species of this genus, *L. fuscipennis* Lepeletier, constructs an egg chamber near the bottom and within the provision (Lieftinck, 1939).

→

Figs. 11-19. Figs. 11-13. Pupa of bombyliid parasite, *Anthrax cintalapa*: (11) Dorsal. (12) Ventral. (13) Lateral. Figs. 14-16. Female pupa of *L. apicalis*: (14) Dorsal. (15) Ventral. (16) Lateral. Figs. 17-19. Male pupa of *L. apicalis*: (17) Dorsal. (18) Ventral. (19) Lateral.



LARVAL HABITS.—The larval feeding habits could not be reconstructed accurately, but apparently the larva moves about the cell, at least during cocoon spinning. In some nests, no cell partitions were found between cocoons; and we concluded that they had been dislodged during cocooning (cell partitions easily fell apart when touched). In nests where larvae had died before cocooning, all cells (22 mm long) were separated by partitions. However, we did find longer cells (44 mm) in some nests. These may have resulted when an egg or larva failed to mature and the larva above or below it dislodged the cell partition and moved the contents of both cells around.

Most fecal pellets were in short and uniform links (Fig. 4) but some ribbon like strands were noted. The shape and color of the pellets were uniform: flattened dorsoventrally, twice as wide as high, round laterally, and yellowish-tan.

The walls of the brood cells were closely lined with silk to make a cocoon that was smooth and shiny on the inside but had loose strands and a crinkled texture on the outside. Cocoon shape was influenced by the configuration of the cell walls, but generally the bottom was round, and the top was flat (Figs. 5, 6). In some cells, additional silk was spun against the cell partition so a cap covered the anterior tip of the cocoon similar to cocoons of another megachilid, *Hoplitis fulgida* Cresson. The cocoons were white when first observed; but after overwintering, they became light brown (cocoons in frozen nests remained white).

Cocoons made in larger cells had feces at either end (Figs. 5, 6), but those in shorter cells had excrement surrounding but not incorporated into the cocoon (Fig. 4). Cocoons spun by female larvae averaged longer, 14.1 (10–17 mm) than those spun by males, 10.6 (8–12 mm).

Prepupal larvae were pale white, C-shaped with an enlarged posterior end, spiculate with sparse, scattered setae (0.06–0.08 mm long), (Figs. 9, 10). The larvae of *L. apicalis* have an atypical setal pattern; other megachilid genera have more setae. Both male and female pupae are illustrated in Figs. 14–19.

OVERWINTERING.—The species entered diapause as a prepupal larvae. The prepupal larvae were rather flaccid and moved slowly after being disturbed and overwintered within the cocoon in this stage.

SEX RATIO.—Only 24 adults emerged; 13 were females.

PARASITES.—Many (41.5%) of the cells contained immature stages of the bombyliid, *Anthrax cintalapa* Cole. These beefly larvae were found within the cocoon of the host, and they overwintered as prepupae. The prepupa and pupa of this parasite are shown in Figs. 7–8, 11–13.

LITERATURE CITED

- LIEFTINCHK, M. A. 1939. Uit het leven van *Lithurgus atratus*, een Indisch houtbijtje. *De Tropische Natuur* 28: 193-201.
- MALYSHEV, S. 1936. The nesting habits of solitary bees. A comparative study. *Eos, Madr.* 11: 201-309.
- MICHENER, C. D. 1951. Genus *Lithurgus* Latreille, p. 1136-7. In C. F. W. Muesebeck et al. *Hymenoptera of America North of Mexico*. Synoptic Catalog. USDA Agr. Monogr. 2, 1420 p.
- MITCHELL, T. B. 1962. Bees of the Eastern United States. Vol. II. Tech. Bull. 152, No. Carolina Agr. Exp. Sta., 557 p.

BOOK REVIEW

AN INDEX TO THE DESCRIBED LIFE HISTORIES, EARLY STAGES AND HOSTS OF THE MACROLEPIDOPTERA OF THE CONTINENTAL UNITED STATES AND CANADA. Harrison Morton Tietz. Published by A. C. Allyn, Allyn Museum of Entomology, Sarasota, Florida. Two Vols. iv + 1042 pp., First Edition, March 1973. Available from Entomological Reprint Specialists, P. O. Box 77224, Dockweiler Station, Los Angeles, California 90007. \$25.00.

This comprehensive bibliography of the described immature stages and reported foodplants of the North American Macrolepidoptera will be welcomed by lepidopterists. An extensive literature has been reviewed by Dr. Tietz, covering the period following Henry Edwards' *Bibliographical Catalogue of the Described Transformations of North American Lepidoptera* (1889) through about 1950. The book, prepared from a manuscript left by Dr. Tietz after his death in 1963, is introduced by W. D. Field and J. F. Gates Clarke. The first volume begins with a list of over 350 periodicals and separate works consulted, followed by a list of nearly 1000 common names of butterflies and moths associated with their scientific names. The main body of the book lists species alphabetically by scientific name. Subspecies, lower taxa and many synonyms are included in this list and are cross-referenced to the main entry under the valid name. Each main entry is followed by a bibliography of life history references and a list of foodplants reported for that species. These entries continue into the second volume. A list of common and scientific names of plants, and a list of foodplants with each entry followed by a list of Lepidoptera reported to feed on that plant are also included.

As a guide to published foodplant records, life history data, and as an aid in attempting to identify immatures, this book is extremely useful. It should not be used as a source of data however. Foodplants are listed without citation of supporting data (oviposition record, larval rearing, etc.) and cross reference to literature sources are not given. In a few cases foodplants are given which are not mentioned in the literature cited for that species.

Although it is regrettable that the book was not published some twenty years ago, anyone investigating nearly any aspect of foodplant ecology of Macrolepidoptera will find it a valuable guide to the literature.—CARLL GOODPASTURE, *University of California, Davis, 95616.*

Subgeneric Classification of *Ephemera*^{1, 2}

(Ephemeroptera: Ephemeridae)

W. P. McCafferty

Department of Entomology, Purdue University, West Lafayette, Indiana 47907

AND GEORGE F. EDMUNDS, JR.

Department of Biology, University of Utah, Salt Lake City, Utah 84112

The distinctive genus, *Ephemera* Linnaeus, is the oldest recognized, the largest in number of species, and the most widespread geographically of all the genera of Ephemeridae. It is primarily of Holarctic and Oriental distribution, and also known from the Ethiopian Region.

The name *Ephemera* was first established by Linnaeus (1758) to include all mayflies. After limiting the genus, Eaton (1868) designated *E. vulgata* L. as its type. Since being comprehensively redefined by Eaton (1883-88) *Ephemera* has maintained relatively stable taxonomic limitations. The ephemerid genera *Eatonica*, *Hexagenia*, and *Ichthyobotus* were originally based on species first described in *Ephemera*. Navas (1922) erected the genus *Nirvius*; subsequently, however, Lestage (1922) synonymized this name with *Ephemera*.

Demoulin (1955) erected the genus *Afromera* for three Ethiopian species, two of which had been originally described as *Ephemera*. McCafferty (1971) described an additional species of *Ephemera* from Africa and first presented evidence for doubting the generic status of *Afromera*. On the basis of a detailed review of all character distribution within the family, we herein designate *Afromera* as a synonym of *Ephemera*: *Ephemera* Linnaeus (= *Afromera* Demoulin **new synonymy**). We therefore presently recognize four described species of *Ephemera* in Africa including *Ephemera congolana* (Demoulin) new combination. The characters used by Demoulin to distinguish *Afromera*, namely the tarsal claws of the male fore legs, the posterior margin of the subgenital plate, and the anastomose venation of the wings, have all been found to be variable to inconsistent degrees on either an individual or specific level throughout *Ephemera*. Furthermore, there is no evidence from the larval stages that would support recognition of a separate genus.

The genus *Ephemera* can best be distinguished from other genera of Ephemeridae by the following characteristics. In both sexes of the

¹ The research on which this report is based was in part supported by grants from the National Science Foundation to the University of Utah, G. F. Edmunds, Jr., Principal Investigator.

² Published with the approval of the Director of the Purdue University Agricultural Experiment Station as Journal Series No. 5124.

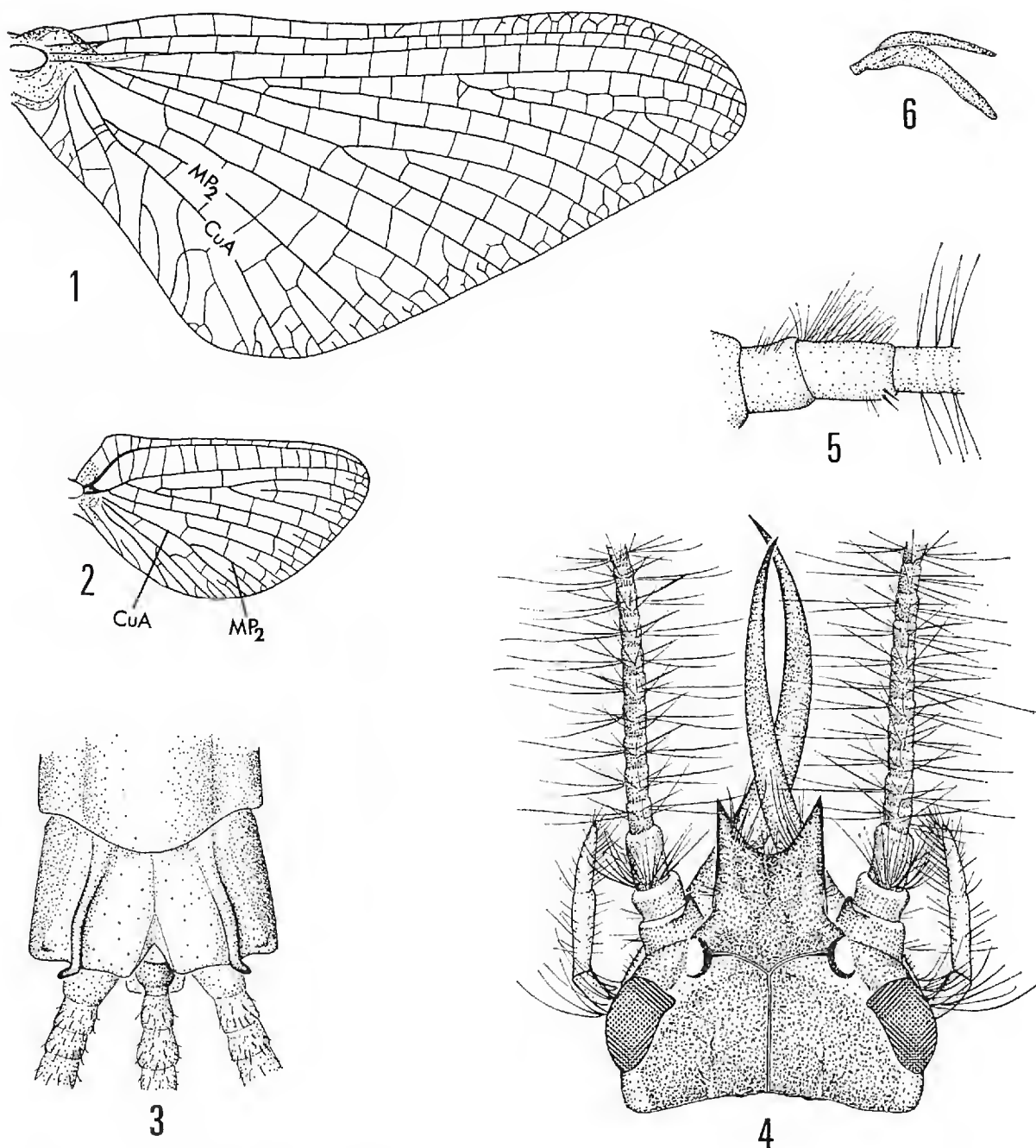


FIG. 1-6. *Ephemera (Ephemera)* spp. 1 and 2. Fore and hind wings, *E. supposita* Eaton. 3. Female terminal abdominal segments, ventral, *E. simulans* Walker. 4. Larval head, *E. supposita*. 5. Antennal base, *Ephemera* sp. 6. Gill 1, *E.* sp.

adults the median terminal filament is subequal in length to the cerci. Other characters common to both sexes are found in the wing venation. In the hind wings (Fig. 2) MP_2 is almost always attached basally to CuA; and in the fore wings there are 3 or more veinlets extending from A_1 to the anal margin. Additionally, in the males the tarsal claws of the fore legs are never hooked and the genital forceps are 4-segmented.

Larval *Ephemera* can easily be differentiated from other larval ephemerids on the basis of the presence of (1) the non-spuriferous bifurcate frontal process, (2) long setae whorled over most of the length

of the antennal flagellae, (3) labial paraglossae which are not extended basally, and (4) the distally rounded tibiae of the fore legs.

The recent study of striking and unusual characteristics possessed by newly discovered larvae from Thailand, India, and South Africa has warranted a subgeneric classification of *Ephemera* as follows.

Subgenus EPHEMERA

(Figs. 1-6)

IMAGO. Length of male body, 10.0-20.0 mm.; fore wings, 8.0-17.0 mm. Length of female body, 12.0-25.0 mm.; fore wings, 10.0-22.0 mm. Fore wings almost always with MP_2 joining CuA at the basal curvature (Fig. 1). Hind wings usually over one third of length of fore wings; at least 1 longitudinal intercalary between R_2 and IR_3 (Fig. 2). Subanal plate of female with posterior margin variously convex (Fig. 3). Terminal abdominal sternum of female as in Figure 3, usually with posterolateral processes.

MATURE LARVA. Frontal process of head longer than wide, but always less than twice as long as wide (Fig. 4). Pedicels of antennae usually with at least 1 heavily sclerotized seta ventrally (Fig. 5). Mandibular tusks slender, circular in cross section, more than twice length of body of mandible; left tusk sometimes more curved, slightly longer, and usually crossing ventrally to right tusk. Labial palpi 3-segmented. Tibiae of prothoracic legs usually with somewhat indistinct comb of stout apical setae of posterodistal margin (similar to Fig. 21). Gill 1 with both forks similar in size (Fig. 6).

ETYMOLOGY.—*ephemeros*, Gr.: short lived.

TYPE SPECIES.—*Ephemera vulgata* Linnaeus, 1758, by subsequent designation (Eaton, 1868).

DISCUSSION. *Ephemera* s.s. is by far the largest and most widely distributed of the subgenera of *Ephemera*. It is cosmopolitan except for the Neotropical and Australian Regions. The character states discussed above when taken in combination will distinguish it from the known stages of the following subgenera.

Dicrephemera new subgenus

(Figs. 7-17)

IMAGO. Fore wings with MP_2 not joining CuA at basal curvature (Fig. 7). Hind wings less than one third of length of fore wings; no longitudinal intercalaries between R_2 and IR_3 (Fig. 8). Subanal plate of female with posterior margin straight (Fig. 9). Terminal abdominal sternum of female as in Figure 9, without posterolateral processes.

MATURE LARVA. Frontal process of head twice as long as wide (Fig. 10). Pedicels of antennae with no heavily sclerotized setae ventrally. Mandibular tusks atrophied (Fig. 11). Labial palpi with second and third segments appearing fused. Tibiae of prothoracic legs usually lacking comb of stout apical setae at posterodistal margin in posterior view (Fig. 12). Gill 1 with outer fork much larger than inner fork (Fig. 13).

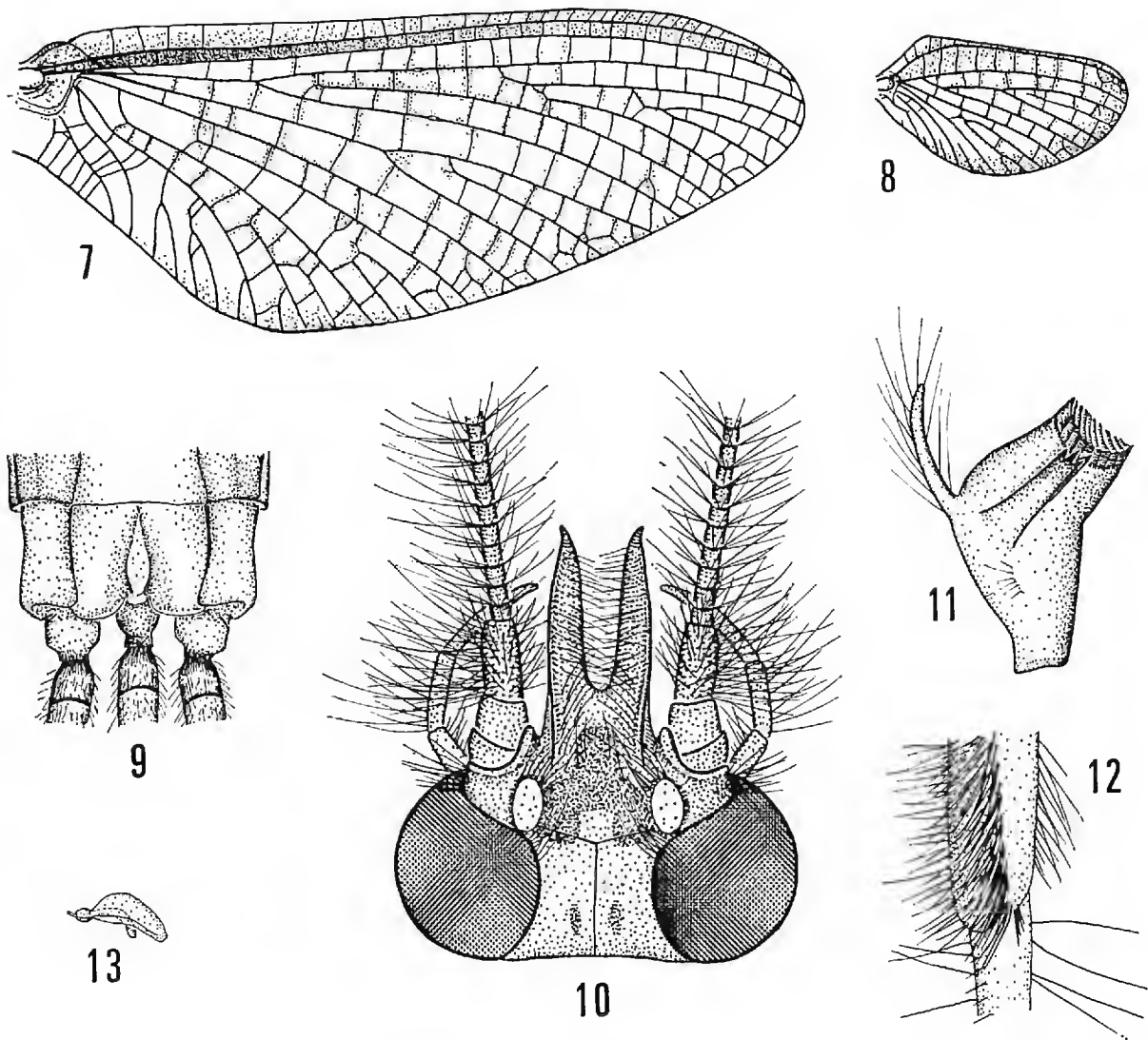
ETYMOLOGY.—*dicros*, Gr.: forked; *ephemerus*, Gr.: short lived.

TYPE SPECIES.—*Ephemerella siamensis* Uéno, 1969. *Ephemerella siamensis* Uéno, 1969, p. 235; institutional custody of male holotype not indicated.

MALE IMAGO (in alcohol). Length: body 11–11.5 mm.; fore wings 10–10.5 mm. Head yellow dorsally, ivory anteriorly, dark brown between bases of ocelli, bases of lateral ocelli black. Antennae with basal segments ivory, terminal segments yellowish-brown to brown. Upper portion of compound eyes grayish-black, lower portion black. Prothorax brown dorsally, white laterally, usually with brown marking posterior to coxae ventrally. Mesothorax and metathorax cinnamon-brown, lateral sutures lighter. Femora of prothoracic legs ivory, tinged with brown apically, tibiae of prothoracic legs dark brown, tarsi light brownish-yellow, tinged with brown proximally. Meso- and metathoracic legs ivory. Wings hyaline, venation reddish-brown, crossveins very lightly margined with same tint. Fore wings with subcostal area shaded dark brown becoming lighter distally, MA fork shaded somewhat at origin. Hind wings smoky reddish-brown marginally. Abdominal terga (Fig. 14) ivory with markings as follows: tergites 3–9 each with pair of dark brown longitudinal markings, markings in tergites 3–7 progressively increasing in length and found almost entirely in anterior half of each segment, markings in tergites 8 and 9 extending nearly entire length of segments, tergite 9 also with thinner submedian longitudinal markings connected posteriorly to broader lateral markings. Abdominal sterna (Fig. 15) ivory with markings as follows: sternite 1 cinnamon-brown except for posterior margins, sternites 3–8 each with pair of thin longitudinal dark brown markings, increasing in length posteriorly, sternite 9 with broad marking covering entire segment posteriorly and tapering anteriorly. Genitalia (Fig. 16) with posterior margin of subgenital plate concave, penes broadly divergent and lobes rounded apically, covered ventrally for almost entire length by thin translucent membrane arising from subgenital plate, titillators short and rounded apically, often covered in ventral view by subgenital plate membrane. Caudal filaments brown.

FEMALE IMAGO (in alcohol). Length: body 10–12 mm.; fore wings 10–10.5 mm. Head dark brown dorsally. Femora of fore legs light brownish-yellow with smoky brown streak along outside margin, tibiae and tarsi of prothoracic legs light brownish-yellow, tibiae tinged with dark brown proximally. Wing venation light brownish-yellow, entire shading occurring in proximal half of subcostal area of fore wing. Abdominal terga variably marked (Fig. 17) but usually yellow with markings as follows: tergite 1 light cinnamon-brown, tergites 3–6 each with pair of broad longitudinal dark brown markings joined posteriorly and becoming faded at junction; tergites 7–9 marked with dark brown nearly throughout except for median stripe, pair of short submedian stripes, and sometimes anterior margin. Abdominal sterna without distinct markings. Caudal filaments pale with brown annulations at apex of proximal segments. Other characters as in male except for usual sexual differences.

MATURE LARVA (in alcohol). Length: body 16–19 mm.; caudal filaments 5–6.5 mm. Color patterns generally corresponding to adults, although usually lighter. Forks of frontal process (Fig. 10) slightly curved dorsally at apices, lateral margins only slightly rounded, dorsal surface covered with short golden setae for nearly entire length; eyes black; labrum slightly emarginate in median third. Pronotum with pair of small dark brown triangular shaped markings, with

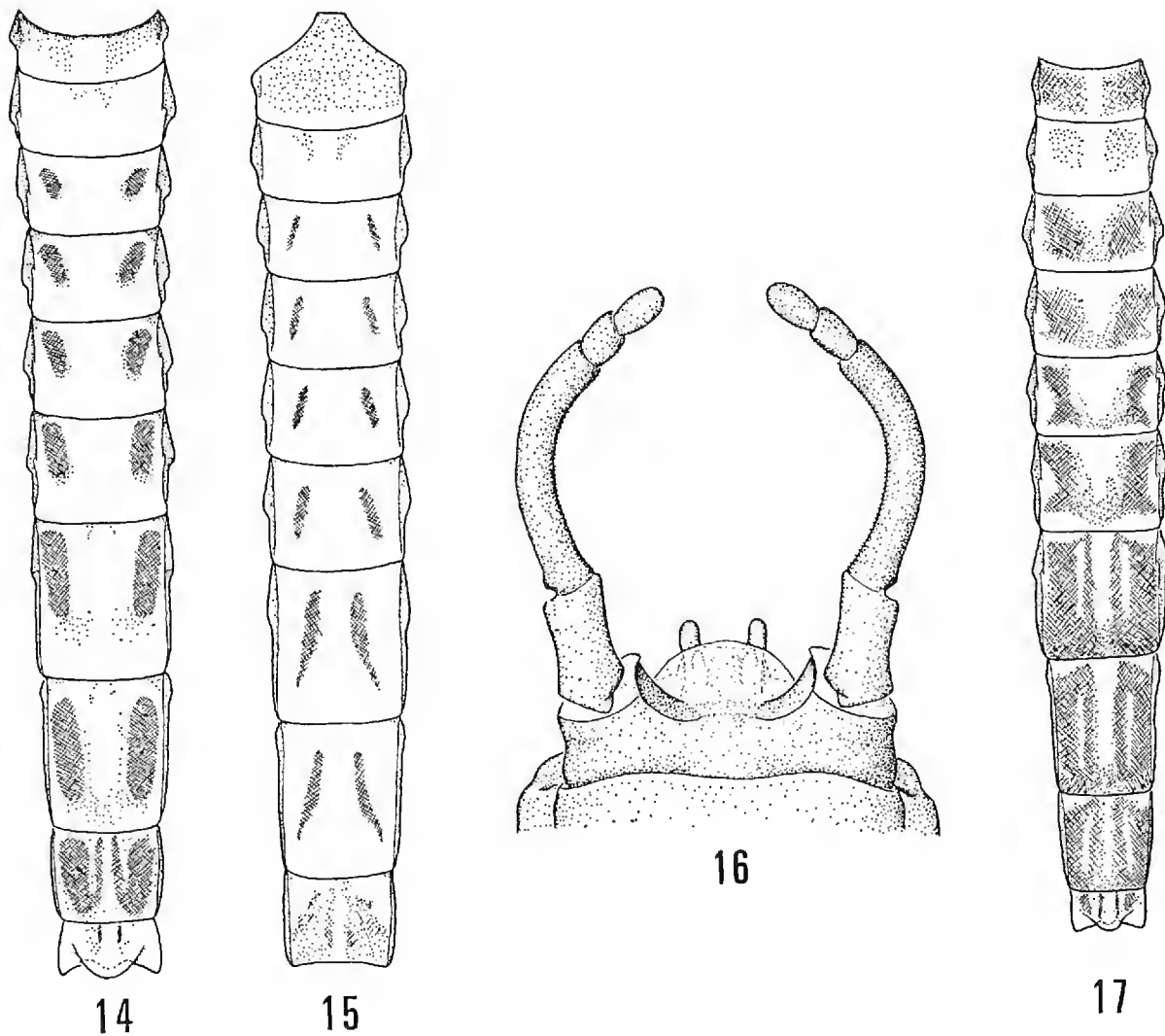


FIGS. 7-13. *Ephemera (Dicrephemera) siamensis* Uéno. 7 and 8. Fore and hind wings. 9. Female terminal abdominal segments, ventral. 10. Larval head. 11. Right larval mandible. 12. Parts of larval tibia and tarsus of left prothoracic leg, posterior. 13. Gill 1.

bases meeting at mid line of notum; legs generally ivory, with prothoracic legs tinged at joints with brown; tibial processes of metathoracic legs tinged with dark brown setae, appearing projected anteriorly due to revolvment of femora. Gills light yellowish-gray. Lateral setae along entire length of filaments, becoming shorter apically.

SPECIMENS EXAMINED. 19 male imagos, 14 male subimagos, 17 female imagos, 16 female subimagos, and 223 larvae as follows: Thailand, Chiangmai Province, Mae Ping, Chiangmai, 1000 feet; 9 November 1964 or 13 November 1964, W. L. and J. G. Peters, collectors. The majority of specimens housed at the University of Utah, Salt Lake City, and representatives deposited with the Laboratory of Aquatic Entomology, Florida A & M University, Tallahassee; Institut Royal des Sciences Naturelles, Brussels; British Museum (Natural History), London; and the Laboratory of Insect Diversity, Purdue University, West Lafayette, Indiana.

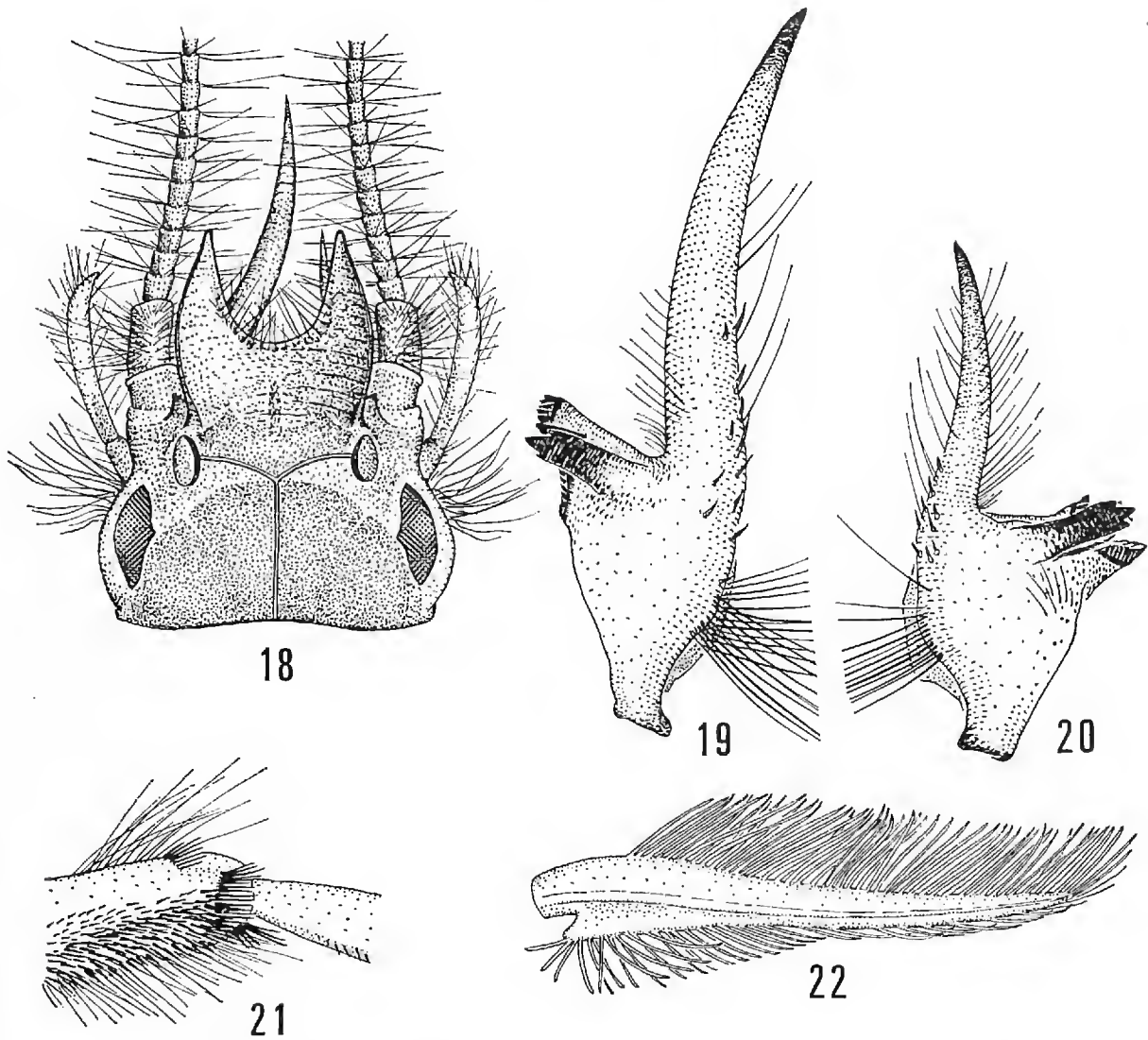
DISCUSSION. *Dicrephemera* presently includes only *E. siamensis* from Thailand; however, we have examined larval specimens from the



FIGS. 14–17. *Ephemera (Dicrephmera) siamensis* Uéno. 14. Male abdominal tergites. 15. Male abdominal sternites. 16. Male genitalia, ventral. 17. Female abdominal tergites.

Bhavani R., in India, and the Wilge R. in the eastern Transvaal, Republic of South Africa, which most assuredly represent undescribed species of *Dicrephmera*. The subgenus is based primarily on the very distinct larval stage, with the absence of well developed mandibular tusks being most diagnostic. The adults are rather weakly differentiated from those of *Ephemera* s.s., and all of the characters discussed must be used with caution. The possibility remains that as more of the larvae of little known *Ephemera* species from the Oriental and Ethiopian Regions are discovered they may prove to be *Dicrephmera*.

Many of the adults of *E. siamensis* were reared from the larvae by Dr. and Mrs. Peters in Thailand, therefore assuring a definite association. The adults of *E. siamensis* are redescribed because of the large series available to us in comparison to the small series upon which Uéno (1969) based his description. The larvae are described herein for the first time.



FIGS. 18-22. *Ephemera (Aethephemera) nadinae*, larva. 18. Head. 19 and 20. Left and right mandibles, lateral. 21. Parts of tibia and tarsus of left prothoracic leg, posterior. 22. Dorsal section of right gill 2.

***Aethephemera* new subgenus**

(Figs. 18-22)

IMAGO. Unknown.

MATURE LARVA. Frontal process of head as long as wide (Fig. 18). Pedicels of antennae with no heavily sclerotized setae ventrally. Right mandibular tusk much reduced, less than three fifths of length of left tusk (Figs. 19 and 20). Labial palpi 3-segmented. Tibiae of prothoracic legs with comb of stout apical setae at posterodistal margin (Fig. 21). Gill 1 with both forks slender (similar to Fig. 6).

ETYMOLOGY.—*aethes*, Gr.: unusual; *ephemeros*, Gr.; short lived.

TYPE SPECIES.—*Ephemera (Aethephemera) nadinae* new species.

MATURE LARVA (in alcohol). Length: body 18.5-20.0 mm.; caudal filaments 6.9 mm. General color dark brown dorsally, brown ventrally, with golden setae and brown spurs. Frontal process of head golden brown, deeply concave anteriorly, lateral margins distinctly rounded, margin of concavity fringed dorsally with long golden setae (Fig. 18); eyes black; labrum emarginate only in median third.

Thoracic notum unicolorous brown; legs generally yellowish-brown, with femora of metathoracic legs darker; dorsal surface of tibiae of prothoracic legs entirely spuriferous; tibial processes of metathoracic legs with dense covering of golden-brown setae. Abdominal terga light brown with pale median and pair of submedian longitudinal markings bordered by dark brown; sterna brown with pair of dark brown submedian longitudinal maculae on segments 7, 8, and 9; gills grayish-purple; dorsal portion of gill 2 (Fig. 22) with inner margin produced ventrally at base; lateral setae along entire length of cerci, and along three fourths of length of terminal filament.

HOLOTYPE.—Mature female larva. South India, Kodaikanal grade, 1600 m.; 30 March 1962, E. S. Ross and D. Cavagnaro collectors. Deposited in the California Academy of Sciences, San Francisco. **Paratype.**—mature male larva (parts on slides) same data and deposition as holotype.

ETYMOLOGY.—*E. (A.) nadinae* is named in honor of the wife of W. P. McCafferty.

DISCUSSION. *Aethphemera* is presently known only from the larval stage, and is known only from India. The distinct subgenus, however, may prove to be more widespread as larvae become known.

ACKNOWLEDGMENTS

We wish to express our gratitude to Mr. R. G. Noble of the National Institute for Water Research, Pretoria, South Africa, for providing us with larval material from Africa. We also wish to acknowledge Mr. Arwin Provonsha, Laboratory of Insect Diversity, Purdue University, for assisting in the preparation of figures.

LITERATURE CITED

- DEMOULIN, G. 1955. *Afromera* gen. nov., Ephemeridae de la faune éthiopienne (Ephemeroptera). Bull. Ann. Soc. Roy. Entomol., 91: 291-295.
- EATON, A. E. 1868. An outline of a re-arrangement of the genera of Ephemeridae. Entomol. Mon. Mag., 5: 82-91.
- 1883-88. A revisional monograph of recent Ephemeridae or mayflies. Trans. Linn. Soc. Lond., Sec. Ser. Zool., 3: 1-352.
- LESTAGE, J. A. 1922. Notes sur le genre *Nirvius* Nav. = *Ephemera* L. Bull. Ann. Soc. Entomol. Belg., 16: 253-254.
- LINNAEUS, C. 1758. Systema naturae per regna tria naturae, secundum classes, ordines, genera, species cum characteribus, differentiis, synonymis, locis. Editio decima, reformata, Tom. I. Laurentii Salvii, Holmiae, 824 pp.
- MCCAFFERTY, W. P. 1971. New burrowing mayflies from Africa (Ephemeroptera: Ephemeridae). J. Entomol. Soc. S. Afr., 34: 57-62.
- NAVAS, P. L. 1922. Efemeropteros nuevos o poco conocidos. Bol. Soc. Entomol. Espan., 7: 54-63.
- UÉNO, M. 1969. Mayflies (Ephemeroptera) from various regions of southeast Asia. Oriental Ins., 3: 221-238.

Four New Species of the Genus *Baetodes*

(Ephemeroptera: Baetidae)

VELMA KNOX MAYO

2702 E. Seneca St., Tucson, Arizona 85716

A detailed description and discussion of the generic characteristics of the nymphs of the genus *Baetodes* is presented by Mayo (1972). Herein are described four new species of *Baetodes* from Mexico, Bolivia, and Venezuela. The genus has not previously been described from Bolivia and Venezuela. Koss (1972) described two new species of *Baetodes* from southwestern United States, the first recorded from North America. He proposed some new terms for structures which have previously been described as spines. Those on the dorsal crests of the femora he called clavate setae. Those along the ventral edge of the tibiae and tarsi he designated as spurs and those on the labrum as spine-like setae. These new terms are used in the following descriptions.

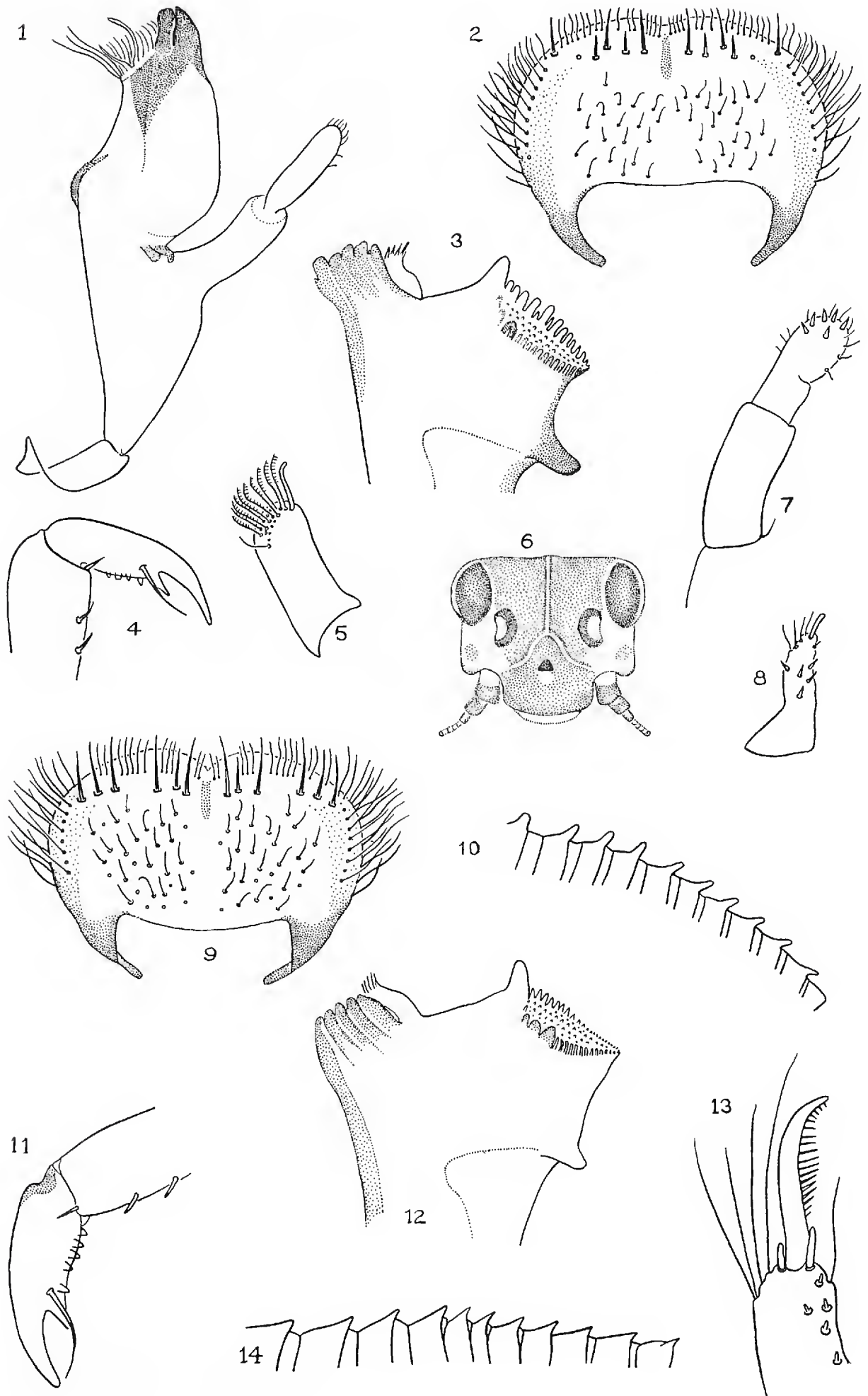
Baetodes proiectus Mayo, new species

(Figs. 1-8, 10)

IMMATURE FEMALE NYMPH.—Body length 6 mm. Caudal filaments broken. *Head*: as in fig. 6; vertex planar between eyes; sides of head planar between eyes and bases of antennae; eyes narrowly rimmed with pale yellow with pale area extending to genae; dark brown between eyes and in fork, on either side of epicranial suture and between antennae; pale spot anterior to small ocellus; labrum dark brown, darker than clypeus; mouthparts as in figs. 1-3, 5, 7, 8; sclerotization along midline behind apical cleft of labrum pronounced; one bladelike seta on tip of each glossa and on tip of each paraglossa, respectively (figs. 8, 5); basal segment of labial palpi longer than other segments combined (fig. 7); two blade-like setae among the slender setae on crowns of maxillae; antennae pale brown, white around bases; intersegmental membranes white. *Thorax*: pronotum dark brown, with few white setae; posterior border elevated at midline forming fairly prominent tubercle; mesonotum dark brown, mottled with yellow laterally and at bases of wing pads; midline white; wing pads brown with pale veins; meta-

→

FIGS. 1-8. *Baetodes proiectus*. Fig. 1. Right maxilla. Fig. 2. Labrum. Fig. 3. Left mandible. Fig. 4. Claw. Fig. 5. Left paraglossa. Fig. 6. Head. Fig. 7. Labial palpus. Fig. 8. Left glossa. Fig. 9. Labrum of *B. peniculus*. Fig. 10. Tubercle of metanotum and abdominal tubercles 1-9 of *B. proiectus*. FIGS. 11-14. *B. peniculus*. Fig. 11. Claw. Fig. 12. Left mandible. Fig. 13. Tip of left glossa showing pinnate seta. Fig. 14. Tubercle of metanotum and abdominal tubercles 1-10.



notum pale, washed with pale brown along anterior border, and with prominent white tubercle posteromedially (fig. 10); pleural sclerites brown, narrowly rimmed with reddish brown posteriorly and medially above coxal articulations; coxae and trochanters light brown; dorsal crests of coxae produced; femora light brown with large pale area proximally, rimmed with dark brown distally; six dark reddish brown clavate setae and fringe of white setae along dorsal crests; tibiae light brown with longitudinal white streak, rimmed with dark brown proximally; tarsi light brown medially, dark brown dorsally at tibial articulations and near claws; claws as in fig. 4; segment I of sternum pale yellow; apodemes dark brown; segment II with brown projection from sclerotized rim of apodeme forming an erect round-tipped lobe. *Abdomen*: terga 1-10 brown, darker than mesonotum, paler at bases of gills; prominent tubercles on abdominal terga 1-9 as in fig. 10; all tubercles pale, slightly tinged with pale brown; abdominal gills white; two elongated gills on each coxa; sternum 1 pale yellow, 2-5 pale brown, 6-9 darker brown; 10 brown laterally, white medially; sternum lighter than terga; Cerci yellow on basal third, brown distally; terminal filament yellow.

MATURE MALE NYMPH.—Length: body 4 mm; caudal filaments 6 mm. Similar to female except anterior thoracic sterna yellow with reddish brown sclerites as on subimago; sternum III pale brown, finely mottled with light brown; abdominal sterna 1-5 pale brown, with broad light brown band on posterior borders; sterna 6-8 dark brown; sternum 9 dark brown on anterior half and along pleural fold, brown area wider at midline, remainder of segment yellowish; sternum 10 yellow with reddish brown streak half way between midline and lateral border branching to each side of bases of cerci; cerci yellowish brown, encircled with small dark brown spines on each segment to two-thirds of length of cerci, distal third brown with intersegmental membranes white.

HOLOTYPE female nymph, L. Pl. 24 km. W. CORIPATA, BOLIVIA, 2/5 May, 1961, P. and P. Spangler, University of Utah collection, Salt Lake City. 6 female and 3 male paratypes, same data as holotype.

DISCUSSION. On sternum II is a brown projection from the rim of the sclerotized area around the apodeme on each side, forming a small, erect, round-tipped lobe on immature specimens. This is unique to the species. On mature specimens this projection is not present, and the sternum is yellow with reddish brown sclerites as in the subimago. The species was named for the projections on immature specimens. On mature male specimens small dark brown spines encircle each segment of the cerci. Mature females are not known. *Baetodes sanctatarinae* Mayo, 1972, has similar spines on the cerci of mature specimens. However there are no abdominal tubercles on *B. sanctatarinae*, while those of *B. proiectus* are prominent.

***Baetodes peniculus* Mayo, new species**

(Figs. 9, 11-14)

MALE NYMPH.—Length: body 5 mm; caudal filaments broken. Dorsum brown with unsclerotized areas pale yellow; venter pale. *Head*: midline and epicranial suture pale; dark brown laterally and in fork; turbinate eyes dark red; pale

yellow laterad to large ocelli; genae brown, pale yellow anterior to small ocellus, pale around bases of antennae; two basal segments of antennae pale ventrally, brown dorsally; distal segments brown; mouthparts as in figs. 9, 12, 13; pinnate bladelike seta apically on each glossa (fig. 13); long straight simple seta medially, slightly curved at tip, on each paraglossa; two pointed bladelike setae among setae on crowns of maxillae. *Thorax*: pronotum amber, midline pale, with two brown stripes on either side of midline and dark brown band along anterior border; mesonotum dark reddish brown laterad of pale midline, amber laterally and on scutellum with paired dark reddish brown spots laterad of midline anterior to scutellum, an elongate dark spot parallel to border of wing pad, and two dark spots anteriorly near bases of wing pads; wing pads amber brown dorsally, yellow ventrally; venation pale yellow; metanotum brown, midline pale with brown tubercle posteriorly (fig. 14); pleural sclerites brown with narrow reddish brown posterior border; coxae and trochanters brown; femora brown with a pale yellow spot near proximal articulation; pale longitudinal stripe and irregular brown border along dorsal crests becoming dark reddish brown at tibial articulations; dorsal crests with six short, barely discernable clavate setae; tibiae brown with distinct white streaks; tarsi brown, darker distally; claw as in fig. 11; sternum white with brown apodemes at leg bases. *Abdomen*: terga 1-3 and 7-10 brown; terga 4-6 yellow dorsally and brown laterally, dark brown along posterior borders; each terga with prominent, pointed, brown tubercle directed posteriorly (fig. 14); abdominal gills oval, white with main tracheole brown at proximal half; few minute setae along margin, especially in basal half; sternum 1 white; sterna 2-9 yellow, anterior and lateral borders washed with brown; sternum 9 darker brown laterally and delicately shaded with brown medially along posterior border; sternum 10 brown laterally, pale yellow medially. Cerci and terminal filament light brown.

FEMALE NYMPH.—Similar to male except for larger size; body length 6 mm. Tubercle on metanotum somewhat larger and tubercle on tergum 1 smaller than in male.

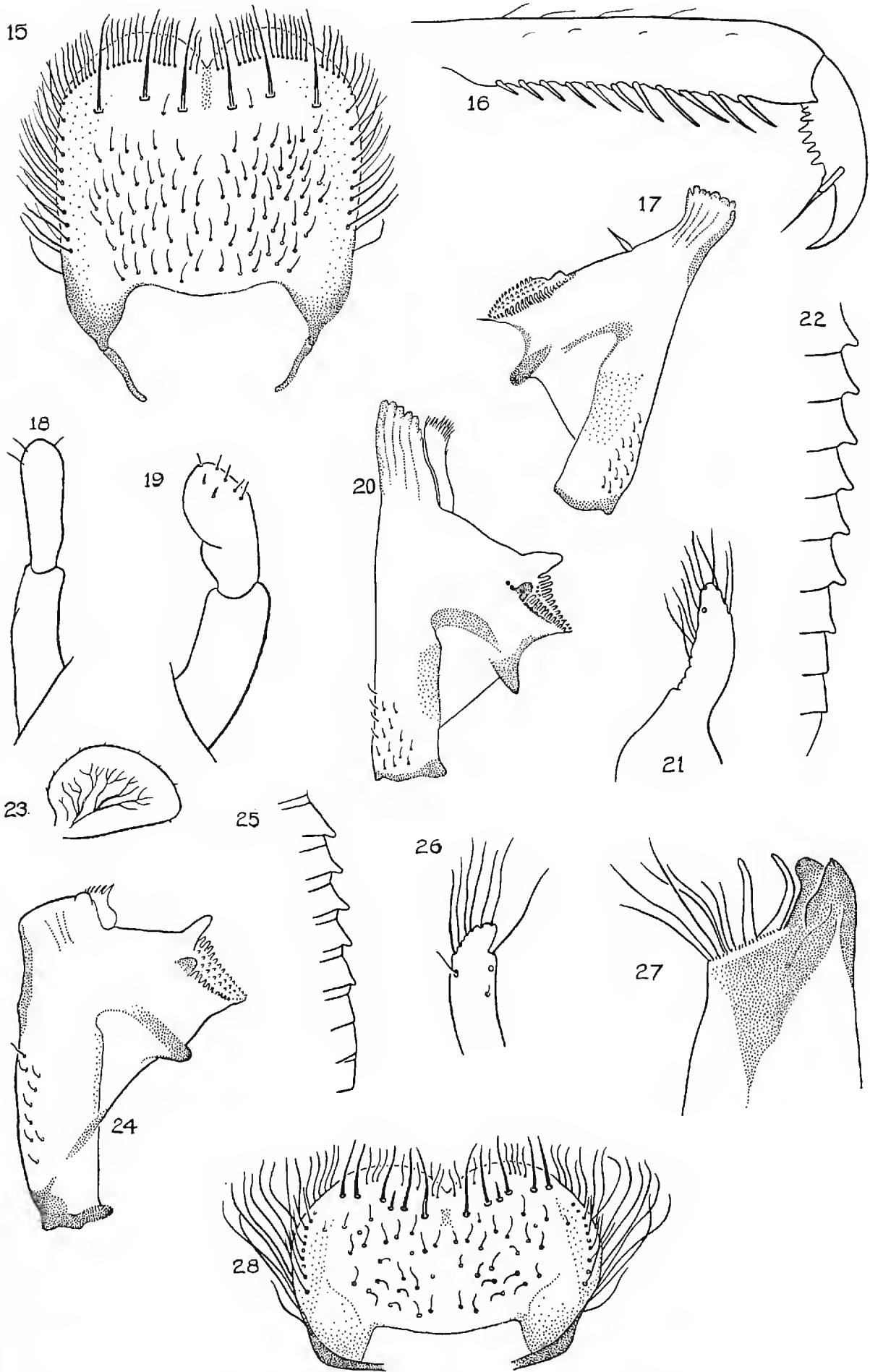
HOLOTYPE MALE NYMPH, Mer., 13 km. E. Apartaderos, Venezuela, 24 February, 1969, P. and P. Spangler. In University of Utah collection, Salt Lake City. Paratypes, 4 nymphs, 2 males and 2 females same data and deposition as holotype.

DISCUSSION: *Baetodes peniculus* has a pinnate seta on the tip of each glossa (fig. 13) and one nonpinnate long straight seta medially on each paraglossa as on *Baetodes sancticatarinae* Mayo, 1972. These species can be distinguished by the absence of abdominal tubercles in *B. sancticatarinae* and the absence of spines on the cerci in *B. peniculus*.

***Baetodes longus* Mayo, new species**

(Figs. 15-23)

FEMALE NYMPH.—Length: body 4 mm, cerci 6 mm. Color yellow with brown markings. *Head*: elongate; light brown between eyes and in fork, pale anterior to small ocellus; antennae pale yellow. Mouthparts as in figs. 15, 17-21. Labrum elongate; with 3 long spine-like setae equidistant from cleft and lateral sclerotized area (fig. 15). *Thorax*: pronotum margined anteriorly with light brown band, mottled with light brown laterad of midline; mesonotum margined anteriorly with



FIGS. 15-23. *Baetodes longus*. Fig. 15. Labrum. Fig. 16. Tarsus and claw. Fig. 17. Right mandible. Fig. 18. Maxillary palpus. Fig. 19. Labial palpus.

reddish brown, and with light brown stripes laterad of midline, mottled with light brown laterally; scutellum and wing pads yellow; metanotum brown with median marginal tubercle posteriorly; pleural sclerites yellow, posterior borders narrowly rimmed with reddish brown, coxal articulations dark brown; legs yellow, trochanters reddish brown distally; femora with 10 or more pale brown clavate setae along dorsal crests; tibiae broadly rimmed with reddish brown proximally, very narrowly rimmed with reddish brown distally, set with minute brown spurs ventrally, these longer distally; tarsi yellow, becoming brown dorsally at bases of claws and with single row of long reddish brown spurs ventrally (fig. 16); claws as in fig. 16. Sternum pale yellow except for brown apodemes at leg bases. *Abdomen*: terga 1-8 yellow with reddish brown anteriorly, darker on terga 1-3; terga 1-7 with prominent yellow tubercles (fig. 22); abdominal gills as in fig. 23; two elongate finger-like gills on each coxa. Sternum 1 pale yellow; sterna 2-10 light yellowish brown. Cerci yellow at basal half, light brown distally. Terminal filament yellow.

MALE NYMPH.—pronotum paler than mesonotum; brown on thoracic sternum anterior to leg bases II and III; abdomen as in female but terga 4-6 pale yellow dorsally half way to pleural fold.

HOLOTYPE FEMALE, RIO FRIO, TAMAULIPAS, MEXICO, 24 December, 1939, L. Berner, in University of Utah collection, Salt Lake City. 78 paratype nymphs, same data and deposition as holotype. 153 paratype nymphs, Rio Guayalejo, Tamaulipas, Mexico, 22 December, 1939, L. Berner. Same deposition as holotype.

DISCUSSION: *Baetodes longus* can be distinguished from all other known species of *Baetodes* by the elongated head and mouthparts (figs. 15, 17, 20) and by the long tarsal spurs (fig. 16). It differs from the Mexican species *Baetodes inermis* Cohen and Allen, 1972 by the following characteristics: the general color of *B. inermis* is much darker than that of *B. longus*; the abdominal tubercles on terga 1-7 of *B. inermis* are poorly developed, those of *B. longus* are prominent; Coxal gills are absent on *B. inermis*, they are present on *B. longus*. Intra-specific variation is as follows; abdominal terga 4-8 may be dark reddish brown anteromedially; terga 9-10 may have brown tracheations along the pleural folds.

***Baetodes furvus* Mayo, new species**

(Figs. 24-28)

MATURE FEMALE NYMPH.—Length: body 4 mm, cerci about 7 mm. Color dark brown with white intersegmental membranes. *Head*: brown with pale yellow midline, narrowly pale yellow around eyes and over small ocellus; mouthparts as

←

Fig. 20. Left mandible. Fig. 21. Right glossa. Fig. 22. Abdominal tubercles 1-7. Fig. 23. Gill. FIGS. 24-28. *B. furvus*. Fig. 24. Left mandible. Fig. 25. Abdominal tubercles 3-7. Fig. 26. Tip of left glossa. Fig. 27. Crown of maxilla. Fig. 28. Labrum.

in figs. 24, 26-28; labrum with 2 long, 1 short, 1 long and 2 spine-like setae laterad at midline (fig. 28); crown of one maxillary fringe of hairs bent mesad revealing two blade-like setae (fig. 27). *Thorax*: pronotum and mesonotum amber mottled with reddish brown; anterior margin of mesonotum dark brown, with paired reddish brown streak laterad of midline terminating in a point followed by an elongate spot, laterally mottled with reddish brown; scutellum and wing pads amber; metanotum dark brown with blunt posteromedial tubercle; pleural sclerites dark brown; femora brown with large yellow area proximally and yellow stripe medially, set with numerous reddish brown clavate setae along dorsal crests, narrowly rimmed with dark reddish brown distally; tibiae brown, narrowly rimmed with reddish brown proximally; tarsi brown, becoming dark brown distally; claw with 8 denticles. *Abdomen*: terga dark brown; intersegmental membranes white; terga 1-6 with prominent tubercles, tubercle on tergum 7 reduced (fig. 25); gills white, oval; coxal gills absent; sterna 2-7 brown with median pale streak and broad pale band subadjacent to gills; sterna 7-9 dark brown laterally, pale medially, with pale portion widening posteriorly; sternum 10 pale amber; cerci light brown, terminal filament pale yellow.

HOLOTYPE FEMALE, CULINAVARA, MEXICO, 1 January, 1948, collector unknown, University of Utah collection, Salt Lake City. 9 paratype nymphs same data and deposition as holotype.

DISCUSSION: *Baetodes furvus* resembles *Baetodes fuscipes* Cohen and Allen (1972) but is distinguished by the following characteristics: *B. fuscipes* has a well developed median posterior elevation on the pronotum, there is no posterior elevation on the pronotum of *B. furvus*; the abdominal tubercles on terga 1-6 of *B. fuscipes* are moderate in size, the tubercles of *B. furvus* are prominent; abdominal terga in *B. fuscipes* vary from dark brown on segments 1-3 to light brown on 9-10, in *furvus* the terga are uniformly dark brown; in *fuscipes* the caudal filaments are light brown, in *B. furvus* pale yellow.

ACKNOWLEDGMENTS

The author wishes to acknowledge the kindness of Dr. Jay R. Traver, University of Massachusetts, for the loan of the collection of *Baetodes* nymphs of Dr. Louis Berner. She is indebted to Dr. George F. Edmunds, Jr., University of Utah for the loan of *Baetodes* nymphs from Mexico, Bolivia, and Venezuela.

LITERATURE CITED

- COHEN, S. D. AND R. K. ALLEN. 1972. New species of *Baetodes* from Mexico and Central America (Ephemeroptera: Baetidae). Pan-Pac. Entomol., 48: 123-135.
- KOSS, RICHARD W. 1972. *Baetodes*: New species and new records for North America (Ephemeroptera: Baetidae). Entomol. News, 83: 93-102.
- MAYO, V. K. 1972. New species of the genus *Baetodes* (Ephemeroptera: Baetidae) Pan-Pac. Entomol., 48: 226-241.

Synopsis of the Genus *Chilenoperla*

(Plecoptera: Gripopterygidae)

CHARLES H. NELSON¹*Department of Biology, University of Tennessee, Chattanooga 37401*

The genus *Chilenoperla* was first described by Illies (1963) in his revision of the South American Gripopterygidae and has been represented by three species all found only in Chile. Recently, while studying stonefly material from South America a new species of this genus, found both in Argentina and Chile, was discovered. Examination of relevant holotype and paratype material of the known species of *Chilenoperla* reveals that Illies mistakenly designated individuals of this undescribed species as paratypes of *Chilenoperla beschi* Illies. Hence, in order to facilitate recognition of this new species descriptions, figures and notes of the other known species of this genus have been included in this study. Unless otherwise indicated, the morphological terms utilized in the present work are those introduced by McLellan (1971) in his study of the Australian Gripopterygidae. An initial estimate of the branching relationship of the four species of this genus is also undertaken and is presented in the form of a Prim Network.

Since the identity of the females of only two species in *Chilenoperla* is known, the key below is confined to males.

KEY TO THE MALES OF CHILENOPERLA

1. Meso-posterior region of central sclerite slightly produced posteriorly (Figs. 1, 18); posterior sclerite demarked from central sclerite (Figs. 3, 19) 2
 Meso-posterior region of central sclerite moderately produced posteriorly (Figs. 6, 11); posterior sclerite not demarked from central sclerite (Figs. 8, 13) 3
2. Sub-anal lobes sharply pointed apically (Fig. 3); anterior sclerite with ventro-lateral projections (Fig. 2) *C. semitincta* Illies
 Sub-anal lobes bluntly pointed apically (Fig. 19); anterior sclerite lacking ventro-lateral projections (Fig. 20) *C. puerilis* Illies
3. Epiproct with less than three tooth-like projections on each side (Figs. 8, 9); posterior sclerite bifurcated apically (Fig. 6); ninth posterior sternal border broadly rounded (Fig. 7) *C. beschi* Illies
 Epiproct with three or more tooth-like projections on each side (Fig. 13, 14); posterior sclerite not bifurcated apically (Fig. 11); ninth posterior sternal border with slight median emargination (Fig. 12) *C. illiesi* Nelson

¹ Research reported in this study partially supported by a University of Chattanooga Foundation grant. Published with the aid of funds from the University of Tennessee, Chattanooga.

CHILENOPERLA SEMITINCTA Illies

(Figs. 1-5)

Chilenoperla semitincta Illies, 1963, Mitt. Schweiz. Entomol. Ges. 36(3): 223-225, fig. 40; a (fore and hind wings), b (male terminalia, ventral), c (male terminalia, dorsal), d (male terminalia, lateral), e (male epiproct, lateral), f (female terminalia, ventral), g (male hind leg, lateral).

Illies, 1966, Das Tierreich, 82: 51.

Zwick, 1972, Studies on Neotrop. Fauna 7: 99.

MALE.—Brown in color with dark brown embossings on the occipital region of head and disc of pronotum. Color of each leg patterned so that proximal region of femur and most of tibia, except for basalmost region, yellow, remainder of leg brown.

MALE TERMINALIA.—Ninth sternite (fig. 2) characterized by posteriorly produced rounded subgenital plate under tenth segment.

Tenth segment (fig. 1) divided transversely by a narrow strip of membrane into anteriorly situated anterior sclerite and a posteriorly situated sclerite, here designated as mesal sclerite (ms). Anterior sclerite becoming greatly narrowed meso-dorsally and ventrally incomplete. Ventro-laterally on each side of anterior sclerite a small difficult to discern projection (fig. 2, p) arising from posteroventral margin. Roughly triangular-shaped mesal sclerite consisting of a central sclerite (cs) and two lateral sclerites (ls). Lateral sclerites situated one on each side of but undemarked from central sclerite.

Small, clearly demarked, triangular-shaped posterior sclerite (figs. 1, 3, ps) of segment eleven attached to posteroventral surface of mesal sclerite. Epiproct very broad basally but narrowing considerably apically (figs. 1, 5). When viewed laterally (figs. 3, 4) margin of each side of antero-dorsal surface bearing four to five small sharply pointed tooth-like projections. Medially, postero-ventral surface of epiproct expanded into a keel-like surface.

Cercus of each side consisting of eight segments. Dorso-basal region of basal cercal segment expanded into a roughly triangular area which extends to lateral sclerite of that side (figs. 1, 3, a).

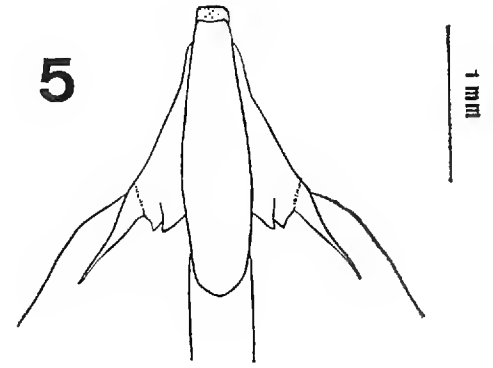
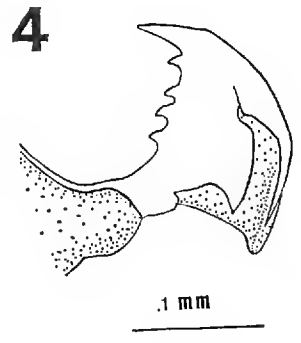
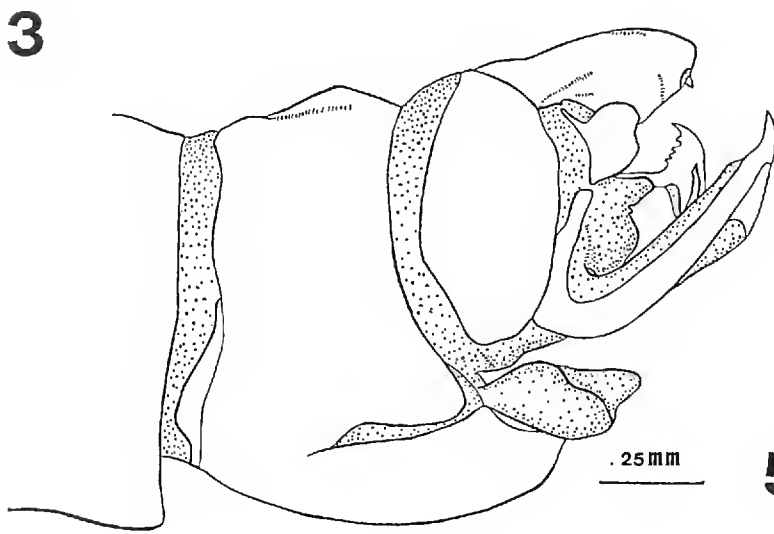
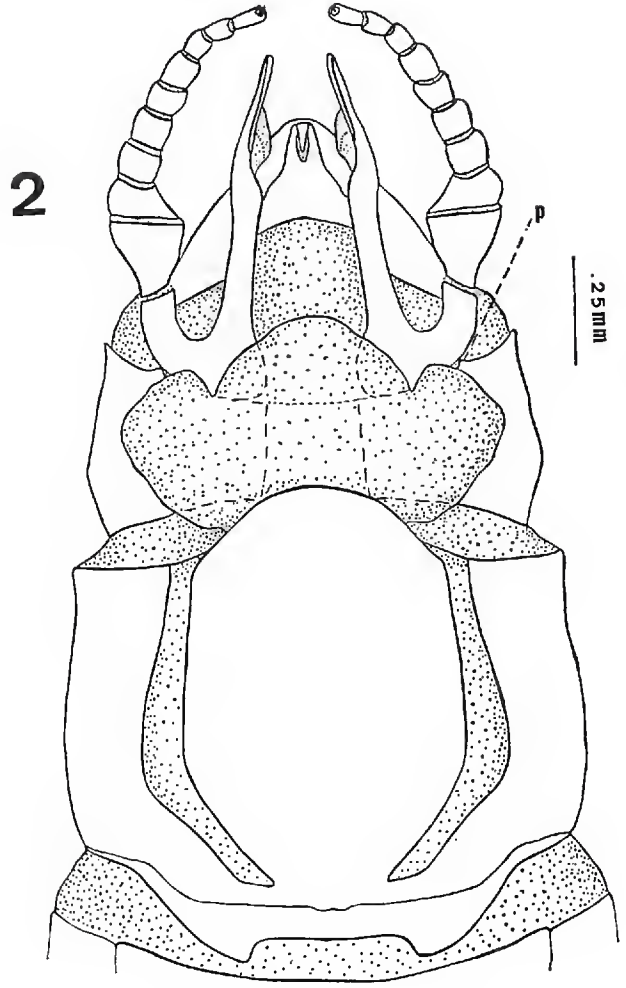
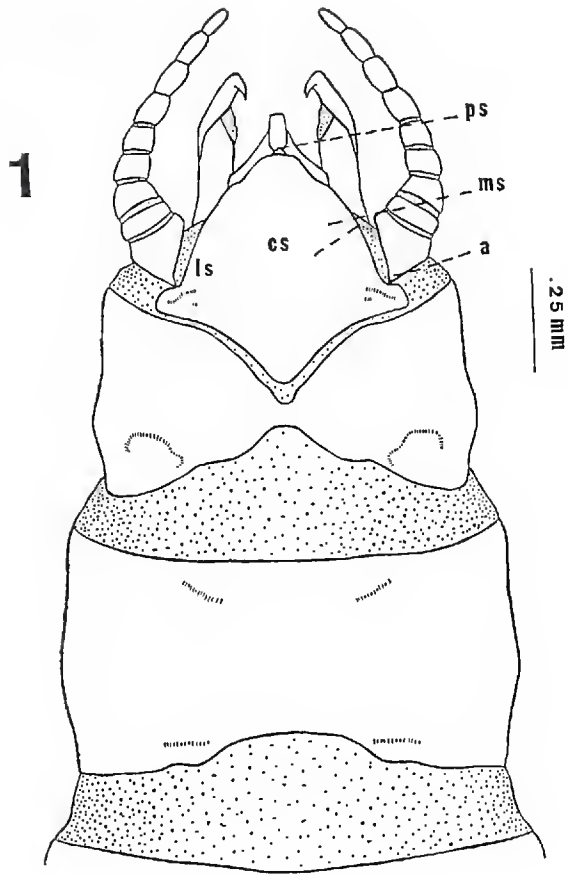
Partly membranous and partly sclerotized sub-anal lobes (paraprocts) in lateral view (fig. 3) hook-shaped in appearance and sharply pointed at apex.

FEMALE TERMINALIA.—The female of this species was not examined during this study. However, if Illies description and figure of the female is accurate the posterior margin of the eighth sternite is slightly convex with a median emargination.

MATERIAL EXAMINED.—Holotype male, Bach bei Niebla (Kustenkordillere), Meershohe, Prov. Valdivia, Chile.

→

FIGS. 1-5 *Chilenoperla semitincta* Illies. Fig. 1. Male terminalia, dorsal view. Fig. 2. Male terminalia, ventral view. Fig. 3. Male terminalia, lateral view. Fig. 4. Male epiproct, lateral view. Fig. 5. Male epiproct, dorsal view. (ms = mesal sclerite; cs = central sclerite; ls = lateral sclerite; ps = posterior sclerite; a = dorso-basal projection of basal cercal segment; p = ventro-lateral projection of anterior sclerite).



CHILENOPERLA BESCHI Illies

(Figs. 6–10)

Chilenoperla beschi Illies (in part), 1963, Mitt. Schweiz. Ent. Ges. 36(3): 225–226, fig. 41; a (male terminalia, ventral), b (male terminalia, dorsal), c (male terminalia, lateral), d (male epiproct, lateral).

Werner, 1965, Beitr. Neotr. Fauna, 4(3): 231.

Illies, 1966, Das Tierreich, 82: 50.

Illies (1963) described the female of *C. beschi* in his original description of this species. The identity of the female was very likely based on the single instance in the type series where males and females were simultaneously collected from the same location. Unfortunately, the males are not members of *C. beschi* but belong to a species to be described in this present study. Hence, the female previously described by Illies as *C. beschi* is most likely that of a new species of *Chilenoperla* and the identity of the female of *C. beschi* needs to be established. Werner (1965) has reported the collecting of both males and females of *C. beschi* from the same site and examination of his material may be useful in determining the identity of the female of this species.

MALE.—Color pattern similar to that of *C. semitincta* except that entire femur of each leg is uniformly brown.

MALE TERMINALIA.—Subgenital plate (fig. 7) very similar to that of *semitincta*. Anterior sclerite (fig. 6) resembling that of *C. semitincta* in being characterized by a small projection arising from the postero-ventral margin of each side. Lateral sclerites, unlike those of *C. semitincta*, clearly demarked from central sclerite. Meso-posterior region of central sclerite appearing to be longer and narrower than those of *C. semitincta* (figs. 6, 8). Posterior sclerite of *C. beschi* not clearly demarked from central sclerite. When viewed dorsally this sclerite becomes bifurcated distally with the apical margin of each half bluntly pointed. Epiproct (figs. 8, 9, 10) bears on each lateral margin of antero-dorsal surface two sharply pointed tooth-like projections. Dorso-basal region of each cercal segment (figs. 6, 8) appearing longer and narrower in *C. beschi*. Sub-anal lobes of *C. beschi* similar to those of *C. semitincta*.

MATERIAL EXAMINED.—Holotype male, Bach bei Niebla (Kustenkordillere), Meershohe, Prov. Valdivia, Chile.

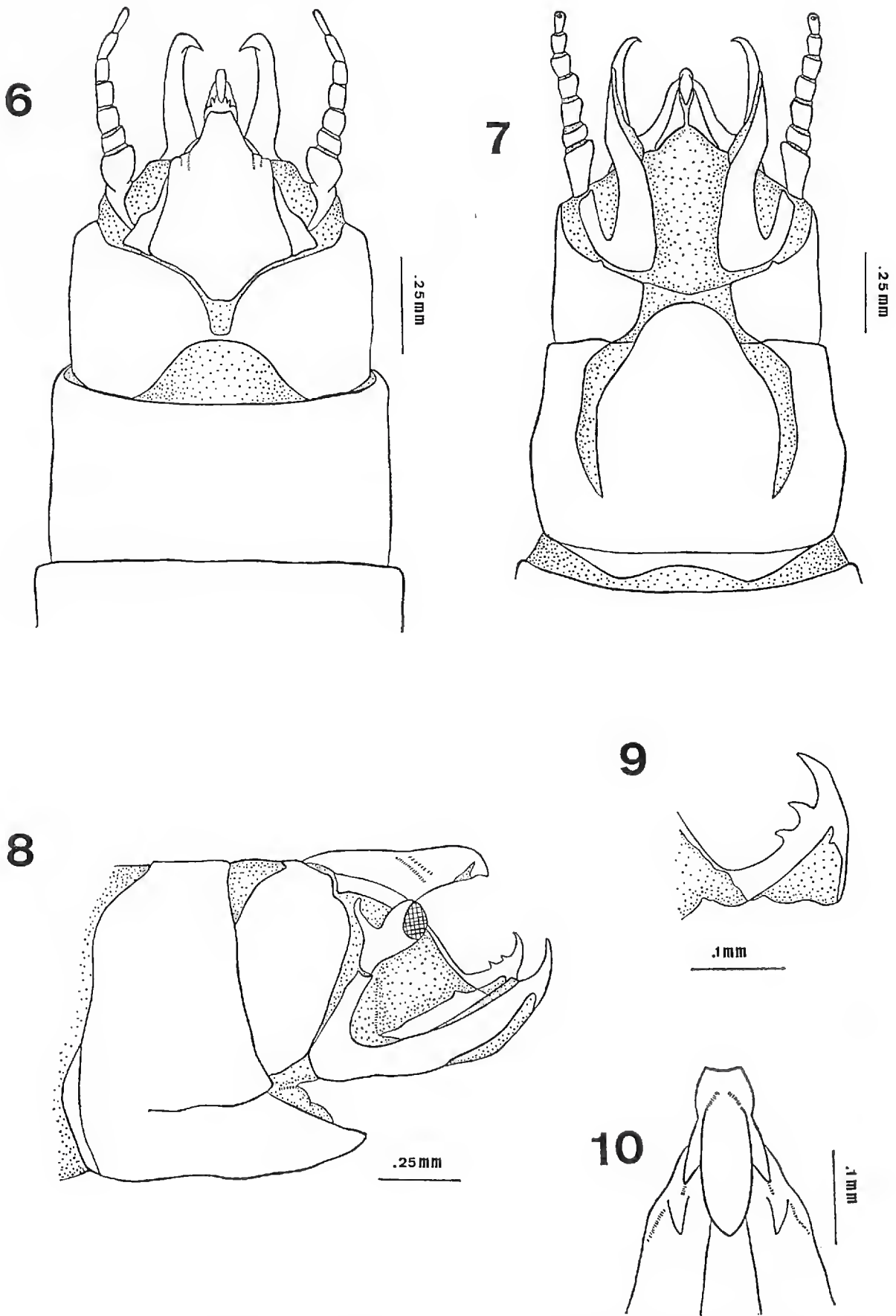
***Chilenoperla illiesi* Nelson, new species**

(Figs. 11–17)

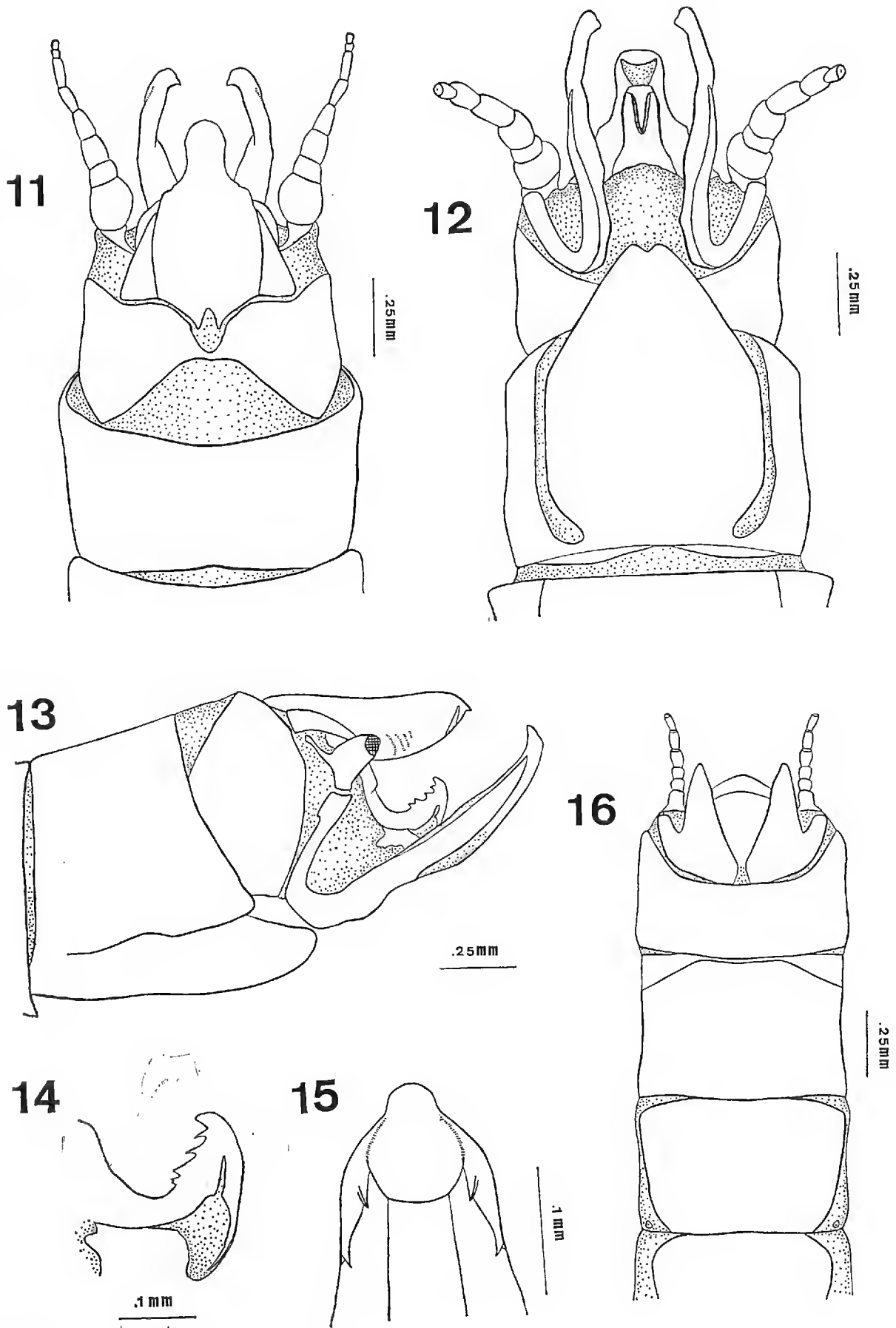
Chilenoperla beschi Illies (in part), 1963, Mitt. Schweiz. Ent. Ges. 36(3): 226, fig. 41; e (female terminalia, ventral).

The color pattern of this species is nearly identical to that of *C. beschi*.

MALE TERMINALIA.—Posterior margin of subgenital plate (fig. 12) with a slight median emargination. Anterior sclerite of *C. illiesi*, unlike those of *C. semitincta* and *C. beschi*, ventro-laterally lacking a projection on each side. Lateral sclerites



FIGS. 6-10. *Chilenoperla beschi* Illies. Fig. 6. Male terminalia, dorsal view. Fig. 7. Male terminalia, ventral view. Fig. 8. Male terminalia, lateral view. Fig. 9. Male epiproct, lateral view. Fig. 10. Male epiproct, dorsal view.



FIGS. 11-16. *Chilenoperla illiesi* Nelson. Fig. 11. Male terminalia, dorsal view. Fig. 12. Male terminalia, ventral view. Fig. 13. Male terminalia, lateral view. Fig. 14. Male epiproct, lateral view. Fig. 15. Male epiproct, dorsal view. Fig. 16. Female terminalia, ventral view.

(fig. 11) clearly demarked from central sclerite. Posterior sclerite of *C. illiesi* similar to that of *C. beschi* (figs. 12, 13) in not being clearly demarked from central sclerite, but not bifurcated. Epiproct (figs. 13, 14, 15) resembling that of *C. semitincta* in having four to five small sharply pointed tooth-like projections on each margin of antero-dorsal surface. Apical portion of epiproct in dorsal view (fig. 15) broader than those of *C. semitincta* and *C. beschi*. Dorsal-basal region of each basal cercal segment (fig. 11) resembling closely that of *C. beschi*.

FEMALE TERMINALIA.—Female (fig. 16) of this species differing from that of *C. semitincta* in that posterior border of eighth sternite being bluntly rounded and lacking any median emargination.

HOLOTYPE MALE, BARILOCHE, PROV. RIO NEGRO, ARGENTINA, Nov. 1926 (R. and E. Shannon). Two males and two females, Fundo Malcho, Cordillera Parral, Prov. Linares, Chile. The holotype will be deposited in the USNM (no. 72595).

This species is named for Dr. Joachim Illies in recognition of his substantial contribution to the knowledge of the Plecoptera.

CHILENOPERLA PUERILIS Illies

(Figs. 18–22)

Chilenoperla puerilis Illies, 1963, Mitt. Schweiz. Ent. Ges. 36(3): 226–227, fig. 42; a (male terminalia, lateral), b (male epiproct, lateral).

Illies, 1966, Das Tierreich, 82: 51.

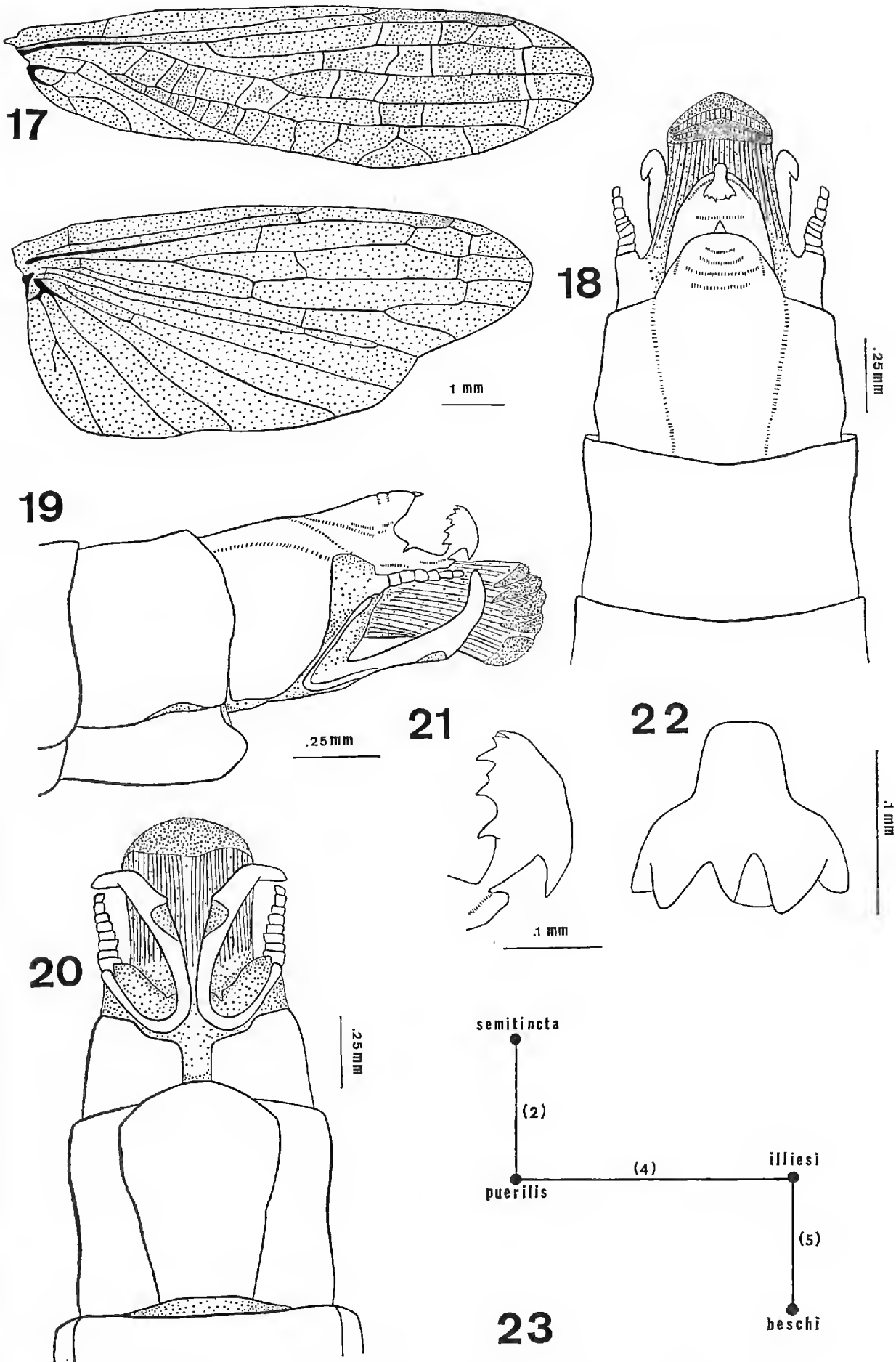
Illies (1963) description of this species is based on the male of a late instar nymph from which the genitalia of the adult could be dissected and examined. However, the determination of the relationship of this species to others in the genus is somewhat hindered in that these adult anatomical features are not completely developed.

MALE TERMINALIA.—Posterior border of ninth sternite (fig. 19) broadly rounded and lacking any median emargination. Anterior sclerite of *C. puerilis* resembling that of *C. illiesi* in lacking a ventro-lateral projection on each side. Meso-posterior region of central sclerite (fig. 18) similar to that of *C. semitincta* in that it is broad and only produced slightly posteriorly. Posterior sclerite (fig. 18, 20) resembling that of *C. semitincta* in being well demarked from central sclerite and triangular in shape. Asymmetrical epiproct (figs. 19, 21, 22) with three to four small sharply pointed tooth-like projections on each margin of antero-dorsal surface. Apical extremity of sub-anal lobes (fig. 19) differing from those of the other species of this genus in being bluntly pointed.

MATERIAL EXAMINED.—Holotype male, Bach bei Laguna Margarita, Puella, Prov. Llanquihue, Chile.

RELATIONSHIP OF THE SPECIES OF CHILENOPERLA

It is premature to construct a phylogenetic history of the species of *Chilenoperla* until more information is available concerning the various stages in the life history of both sexes of all species. However, an initial approximation, utilizing available characters, can be made in



FIGS. 17-23. Fig. 17. *Chilenerla illiesi* Nelson, wings. Figs. 18-22. *Chilenerla puerilis* Illies. Fig. 18. Male terminalia, dorsal view. Fig. 19. Male terminalia, lateral view. Fig. 20. Male terminalia, ventral view. Fig. 21. Male

TABLE 1. Data Matrix consisting of the character states for the species of *Chilenoperla*. Missing character states are designated by (-).

SPECIES	CHARACTERS											
	1	2	3	4	5	6	7	8	9	10	11	12
<i>C. semitincta</i>	0	0	0	1	1	0	0	0	0	0	1	0
<i>C. beschi</i>	1	-	0	1	0	1	1	1	1	0	0	0
<i>C. illiesi</i>	1	1	1	0	0	1	1	0	0	1	0	0
<i>C. puerilis</i>	-	-	0	0	-	0	0	0	0	-	-	1

the form of a network based on phenetic differences (*sensu* Farris, 1967) between species. A network depicts only the branching relationship of the species included and requires that no judgments be made concerning the relative primitiveness or advancement of a character. In this study a Prim Network, utilizing the procedure described by Farris (1970) was constructed for the known species of *Chilenoperla*. Although, in some cases Prim Networks may not yield as reliable an estimate of branching relationships as do other quantitative cladistic techniques (e.g., Wagner Networks) they do have advantages in that they require a minimal amount of computation and do not necessarily involve the use of a computer.

The Prim Network constructed during this study (Fig. 23) indicates a close phenetic relationship between *C. semitincta* and *C. puerilis*. *Chilenoperla illiesi* is nearly equidistant from *C. puerilis* and *C. beschi* but is closer to the former species than to the latter. Analysis of the data matrix (Table 1) of the four species reveals that *C. semitincta* and *C. puerilis* have identical states for five characters (3, 6, 7, 8 and 9). *Chilenoperla illiesi* shares with *C. puerilis* identical states for three characters (4, 8 and 9) and with *C. beschi* identical states for six characters (1, 5, 6, 7, 11 and 12).

DESCRIPTIONS OF CHARACTERS.—(1) femur: monocolored = 0; bicolored = 1.
 (2) female eighth posterior sternal border: not emarginate = 1; emarginate = 0.
 (3) Male ninth posterior sternal border: not emarginate = 0; emarginate = 1.
 (4) Male ventro-lateral projections of anterior sclerite: absent = 0; present = 1.
 (5) Male lateral sclerites: demarked from central sclerite = 0; undemarked = 1.

←

epiproct, lateral view. Fig. 22. Male epiproct, dorsal view. Fig. 23. Branching relationship of the four species of *Chilenoperla* as produced from the Prim Network. The lengths of the internodes are given in parentheses.

(6) Male meso-posterior region of central sclerite: slightly produced posteriorly = 0; moderately produced posteriorly = 1. (7) Male posterior sclerite: demarked from central sclerite = 0; not demarked = 1. (8) Male posterior sclerite: not bifurcated apically = 0; bifurcated apically = 1. (9) Number of tooth-like projections on each side of male epiproct: three or greater = 0; less than three = 1. (10) Apical region of male epiproct: narrow = 0; broad = 1. (11) Dorso-basal region of male basal cercal segment: long and narrow = 0; broad and triangular-shaped = 1. (12) Sub-anal lobes: sharply pointed apically = 0; bluntly pointed apically = 1.

ACKNOWLEDGMENTS

The author would like to thank Dr. Oliver S. Flint, Jr., of the United States National Museum and Dr. Peter Zwick of the Max-Planck Limnology Institute, Schlitz, Germany for the loan of the material utilized in this study. The author would also like to thank Dr. Lane P. Lester and Dr. Gene S. Van Horn for their critical reading of the manuscript.

LITERATURE CITED

- FARRIS, J. S. 1967. The meaning of relationship and taxonomic procedure. *Syst. Zool.*, 16: 44-51.
 1970. Methods for computing Wagner Trees. *Syst. Zool.* 19: 83-92.
 ILLIES, J. 1963. Revision der sudamerikanischen Gripopterygidae. *Mitt. Schweiz. Entomol. Ges.*, 36: 145-248.
 1966. Katalog der rezenten Plecoptera. *Das Tierreich*. No. 82: I-XXX, 1-632.
 McLELLAN, I. D. 1971. A revision of Australian Gripopterygidae (Insecta: Plecoptera). *Australian Jour. Zool.*, Sup. No. 2: 1-79.
 WERNER, E. 1965. Beitrag zur kenntnis der Chilenischen Plecopteren. *Beitr. Neotr. Fauna*, 4(3): 227-233.
 ZWICK, P. 1972. On *Neonemura illiesi* nov. spec. and some other stoneflies from Chile (Ins., Plecoptera). *Stud. Neotrop. Fauna*, 7: 95-100.

SCIENTIFIC NOTE

Synonymy in *Pampoconis* (Neuroptera, Coniopterygidae).—Meinander, 1973 (*Notulae entomologicae* 52: 25) described *P. dentifera*, and summarized the differences between that species, *P. latipennis*, "*P. punctipennis* Adams in litt.," and "*P. uncinata* Adams in litt." While an inadvertent error, this appears sufficient to make the last two names available nomenclatorially. *P. punctipennis* Adams, 1973, and *P. uncinata* Adams, 1973 (*Pan-Pac. Entomol.* 49: 250-254) are therefore synonyms of *P. punctipennis* Meinander, 1973 and *P. uncinata* Meinander, 1973, and the specimens designated as holotypes are to be regarded as lectotypes.—PHILLIP A. ADAMS, *Department of Biological Science, California State University, Fullerton, California, 92634.*

Some new taxa in the Myrmosinae with keys to
the females in North America

(Hymenoptera: Tiphidae)

MARIUS S. WASBAUER

Laboratory Services, California Department of Food and Agriculture,
Sacramento 95814

The Holarctic tiphid subfamily Myrmosinae consists of moderate to small sized wasps in which there is a strong sexual dimorphism. The males are fully winged with a distinctly tripartite mesosoma and are either entirely black or black with the metasoma reddish. They are often much larger than the females which are apterous, have a bipartite mesosoma with a single functional suture and are reddish to brown in integumental color, often with part or all of the metasoma and sometimes part of the mesosoma black. In addition, the metasoma of the females may have cream-colored integumental markings. Both sexes are known for *Myrmosa* and *Myrmosula*. The Nearctic *Myrmosina* is known from males only.

The purpose of this paper is to provide the description of a new genus of Myrmosinae from the Colorado Desert of Southeastern California and descriptions of three new species of the Genus *Myrmosula*. In addition, keys are presented to the females of the genera of Myrmosinae and the species of *Myrmosula*.

For making possible the loan of material used in this study, I wish to thank the following persons and the institutions they represent: P. H. Arnaud, Jr., California Academy of Sciences, San Francisco (CAS); R. M. Bohart and R. O. Schuster, both University of California, Davis (UCD); J. A. Chemsak, California Insect Survey, University of California, Berkeley (CIS); J. C. Hall and S. Frommer, both University of California, Riverside (UCR); and K. V. Krombein, United States National Museum (USNM). Mrs. Ellen Parker prepared the illustrations.

In the following descriptions, the head is considered prognathous. Measurement of the propodeal width is between the outer rims of the spiracles. Explanation of abbreviations used for mensural ratios is given by Wasbauer (1968).

***Leiomyrmosa*¹ Wasbauer, new genus**

ADULT FEMALE.—Head, in posterior view, somewhat narrowed behind eyes, in dorsal view, rounded; antennal insertions covered only by thin, narrow lamellae;

¹ Gr. *Leios*: smooth, and *Myrmosa*: a combination of the Gr. *myrmex*—ant and L. *osus*—having the condition or quality of.

ocelli absent; clypeus evenly convex, without median proximal spine or tooth; mandibles tridentate, without lamella on ventral margin; legs slender, not heavily armed with spines; anterior coxa without tooth at anterior apex; anterior tarsi with well developed rake, outer apical angle of first and second tarsal segments with somewhat spatulate spine which is as long as succeeding segment, third and fourth segments with progressively shorter, less spatulate spines, outer surface of anterior basitarsus with row of several short spines; hind coxa dorsally at base with low, rounded elevation; first metasomal sternum with small, low, toothlike elevation anteriorly; pygidium not differentiated.

MALE.—Unknown. Possibly *Myrmosina* Krombein.

TYPE OF GENUS.—*Leiomyrmosa spilota* Wasbauer.

Leiomyrmosa appears to represent a modification of the *Myrmosa* line. This modification has been mainly toward loss or reduction of existing structures as shown by the lack of a clypeal spine, lack of ocelli, shallow punctation of the head, greatly reduced punctation of the mesosoma, lack of abundant erect pilosity, especially on the metasomal terga, the small elevations on the posterior coxae and the presence of only a very small tooth on the first metasomal sternum. It may be further distinguished from *Myrmosa* by the presence of a tarsal rake and from *Myrmosula* by the head narrowing immediately behind the eyes, the tridentate mandibles, without ventral lamellae, the lack of elevations at the anterior extremities of the hypostomal carinae and absence of a tooth anteriorly at the apex of the anterior coxa.

At present, the type is the only species known.

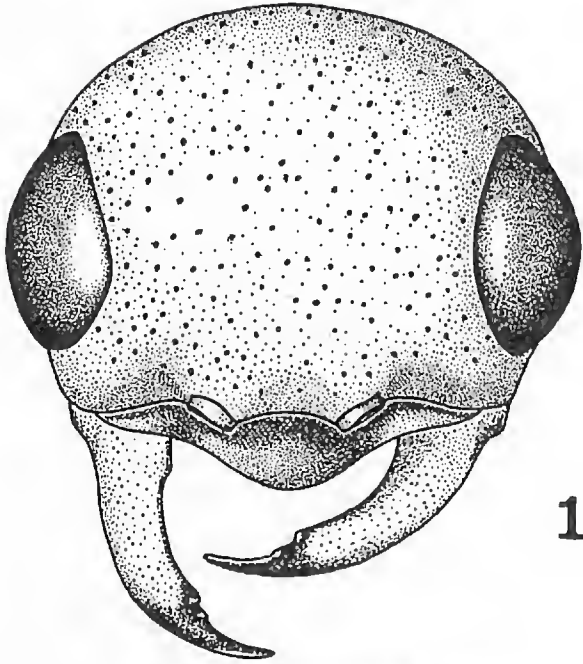
Leiomyrmosa spilota Wasbauer, new species

(Figs. 1, 2, 19, 23)

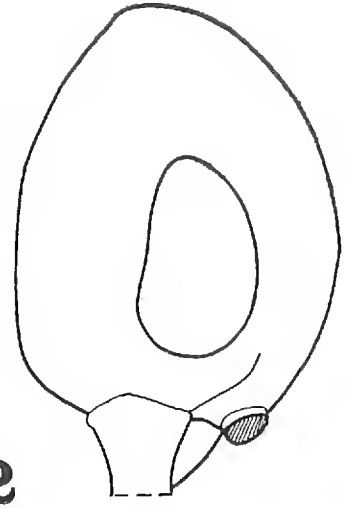
HOLOTYPE FEMALE.—Head, mesosoma and metasoma uniformly orange-brown except a pair of enamel white spots anteriorly on sides of second metasomal tergum; antennae darkened apically, apical third of mandibles reddish-black. Entire insect shining, head with small, shallow punctures, sparse on vertex, separated by an average of about their diameter on frons, less than their diameter on clypeus; mesosoma impunctate laterally with faint integumental reticulation; dorsum of pronotum and mesonotum with small, shallow punctures separated by average of somewhat more than their diameter, propodeum nearly impunctate. Metasoma with few small, shallow, scattered punctures before apex of each segment. Vestiture very sparse, consisting entirely of erect, straw-colored hairs, very short, scarcely noticeable on frons, vertex and dorsum of mesosoma and metasoma except for a few long hairs on pronotum anterolaterally and numerous shorter

→

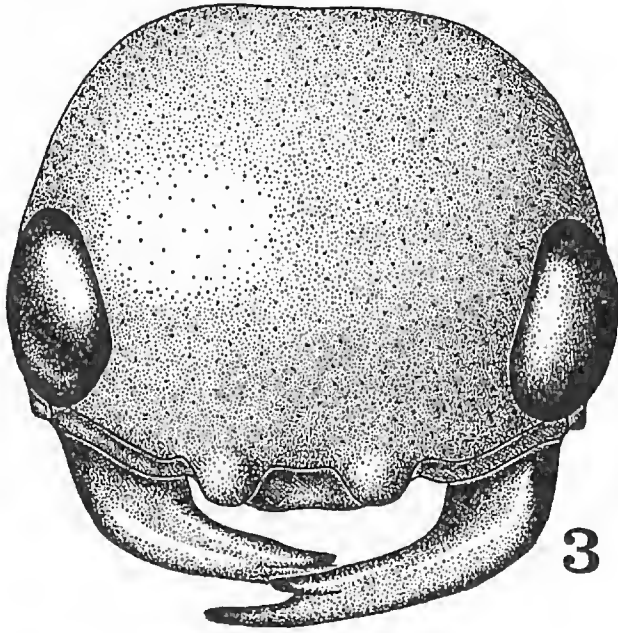
FIGS. 1-6. Heads of female Myrmosinae. Dorsal view on left, right lateral view on right. Figs. 1-2. *Leiomyrmosa spilota*. Figs. 3-4. *Myrmosula parvula*. Figs. 5-6. *Myrmosula exaggerata*.



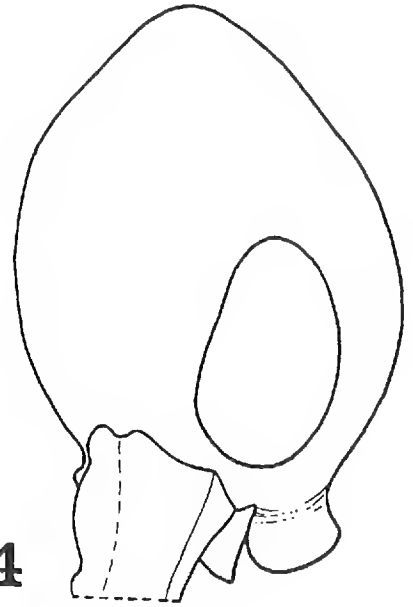
1



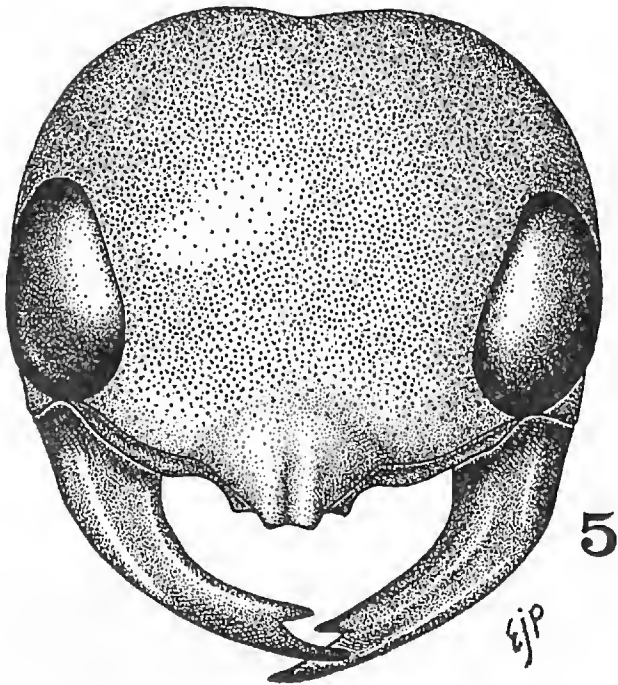
2



3

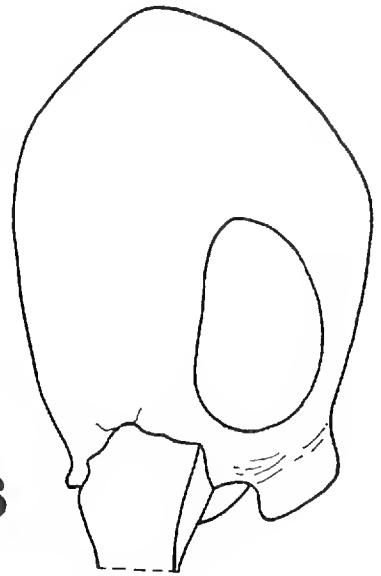


4



5

ejp



6

hairs on anterior, declivous portion of first metasomal tergum; longest on clypeus, underside of head, prosternum and coxae; metasomal sterna with scattered long hairs before apex of each.

Head.—Rounded, slightly broader than long, TFD/FD 1.15, EH/FD 0.49, EH/MID 0.59, MID/TFD 0.72; vertex extending in an even arc above tops of compound eyes; antennae short, first four antennal segments in ratio of 3: 1: 1.2: 1.2; median lobe of clypeus convex in profile, apical margin simple, convex, without median lamella; mandible with apical tooth long, acute, proximal teeth very small; occipital carina incomplete ventrally; maxillary palpi six segmented, labial palpi four segmented.

Mesosoma.—Width ratios of mesosomal nota: pronotum 1.3; mesonotum 1.0; propodeum 1.2; pronotal length (measured from anterior margin of collar to apex of segment) 0.76 times width, humeral angles rounded, without projections. Vestiture of legs consisting of sparse, long, erect hairs, without appressed hairs or pubescence; anterior tibia without preapical spines, tibial spur spatulate, 0.73 times length of basitarsus; middle tibia with three rows of short, slender, slightly curved spines on anterior surface, dorsal row with six spines; posterior tibia with two spine rows.

Metasoma.—First tergum smooth, without carinae or ridges.

Length.—3.50 mm.

Variation ($n = 9$); length 2.68–3.65 mm.; TFD/FD 1.11–1.17; EH/FD 0.45–0.51; EH/MID 0.55–0.62; MID/TFD 0.71–0.75; color light reddish brown to nearly black (1 specimen). All paratype material was preserved in 70% alcohol before mounting and some color change was noted. On some specimens, for example, the white spots on the second metasomal tergum became very faint. However, the very dark paratype was nearly black in color when collected, so apparently considerable color variation occurs in nature.

HOLOTYPE (CAS #11896) and six paratypes 1 MILE WEST BLYTHE, RIVERSIDE COUNTY, CALIFORNIA, May 23–24, 1970, in cereal bowl pit traps, J. L. Johnson and M. Washbauer collectors (CAS, MSW); two paratypes, same locality, May 6, 1970, J. L. Johnson and E. L. Paddock collectors (USNM).

The type locality is a somewhat disturbed sand dune area on the edge of extensive cultivated fields. The first two or three inches of sand is loose and unconsolidated. Beneath this is packed, consolidated sand. The major plants in the immediate area are *Larrea divaricata*, *Franseria dumosa* and *Prosopis juliflora*. One hundred cereal bowl pit traps were deployed in an area roughly 40 by 40 feet. All specimens were taken in these between 5:00 and 8:00 p.m. Pacific Daylight Time.

MYRMOSULA Bradley

As currently recognized, the genus *Myrmosula* includes species restricted to the Nearctic region. Krombein (1940) recognized four species, one based on both sexes, one based on the male and two based on the female. Mickel (1940) described a fifth from the female and presented a key to the North American females. Krombein (1946) proposed still another species based on the female, and the descriptions

presented below bring the total to nine species for North America. Only one of these species, the widespread *M. parvula* (Fox) occurs in the eastern United States. Krombein (1940) gives its distribution as westward to Texas and Montana. The remainder are of more limited distribution in the western United States. One species is here described from Baja California Sur.

***Myrmosula nasuta* Wasbauer, new species**

(Figs. 7, 8, 20)

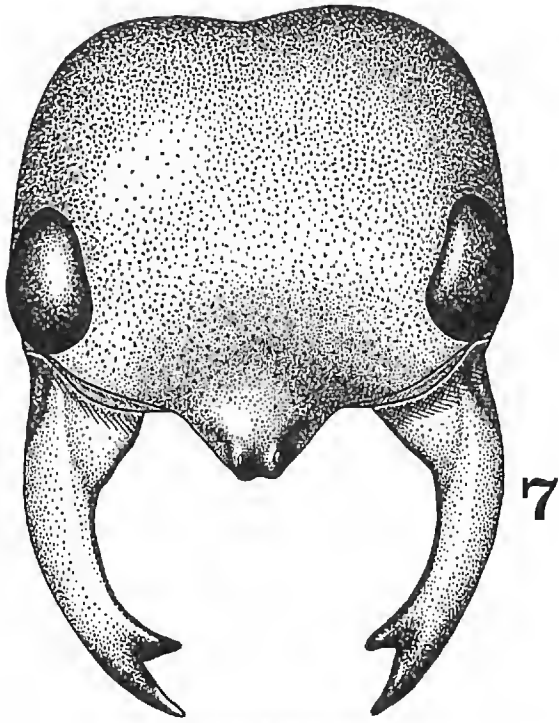
HOLOTYPE FEMALE.—Entirely orange-brown; tarsi somewhat darkened; tips of mandibles reddish black; second, third and fourth metasomal terga with dark brown apical band, interrupted medially on second and fourth; ultimate tergum entirely dark brown; second tergum with pair of anterolateral, creamy white, comma-shaped spots; fifth tergum with medioapical creamy white spot. Entire insect shining, punctation minute, punctures on vertex separated by average of less than their diameter; on frons and lower face slightly larger, separated by somewhat more than their diameter; on mesepisternum, slightly larger, separated by less than their diameter; sparse, scattered on lateral posterior surfaces of propodeum. Vestiture consisting of very short, erect to suberect hairs forming dilute pubescence over most of body, giving distinct sheen to head in certain lights and loose plush-like appearance to metasomal terga. Longer, slender, erect hairs numerous on gena, occiput, pronotum, propodeum, first metasomal tergum and legs, scattered on metasomal sterna.

Head.—Frons strongly produced into rather narrow, nasutiform projection, in lateral view truncate apically, bearing a pair of short, parallel ridges which are angulate posteriorly, posterior slope somewhat concave, in dorsal view, not bifurcate at apex; slightly curved row of three shallow dimple-like depressions immediately posterior to interantennal projection; medioapical margin of clypeus subtruncate, distinctly angled at junction with lateroapical margin; mandibles slender, long, dorsal tooth considerably shorter than ventral tooth, basal mandibular lamella low, convex; hypostomal carina produced into noticeable recurved tooth just mesad of posterior mandibular condyle, visible below mandibular lamella.

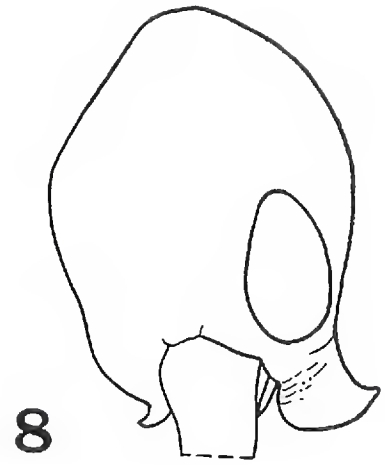
Mesosoma.—Propodeum in dorsal view wider than remainder of mesosoma. Width ratios of mesosomal nota: pronotum 1.00, propodeum 1.13; anterior tarsus with hairs of ventral basitarsal comb equal width of basitarsus at their bases; propodeum without carina near spiracles, posterolateral surfaces smooth.

Length.—4.45 mm.

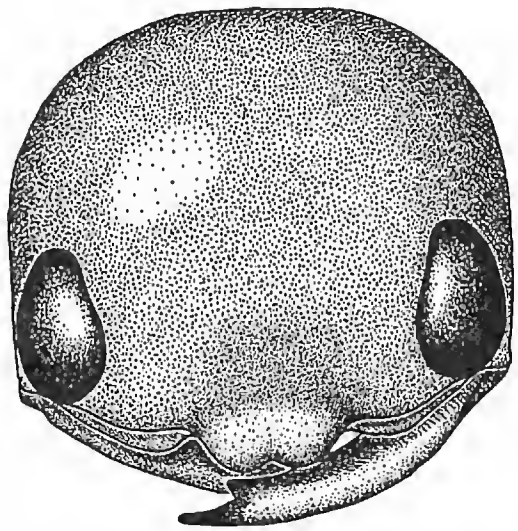
HOLOTYPE (UCD #794), 18 MILES WEST BLYTHE, RIVERSIDE COUNTY, CALIFORNIA, October 15, 1965, F. D. Parker collector (UCD). **Paratypes** (12): one female, Seeley, Imperial County, California, March 20, 1968, on ground at sundown, J. L. Johnson collector (MSW). One female, Imperial County, California, April, 1917, J. C. Bridwell collector (USNM). One female, Glamis, Imperial County, California, April 8, 1964, R. M. Bohart collector (MSW). One female, same locality, April 12, 1969, sand dunes, A. R. Hardy collector (UCR). One female, Cathedral City, Riverside County, California, April 11, 1941, ex: kangaroo rat burrow, Ross and Aarons collectors (CAS). One female, sand dunes, 7 miles southwest of Kclso, San Bernardino County, California, April 16–17, 1969, M. S. and J. S. Wasbauer



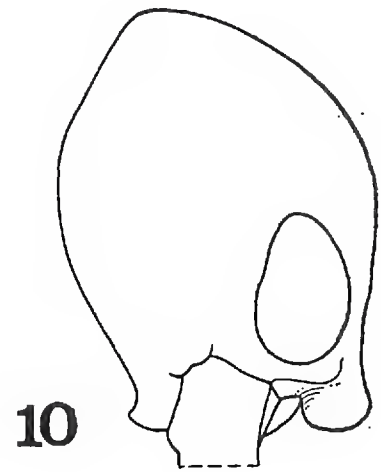
7



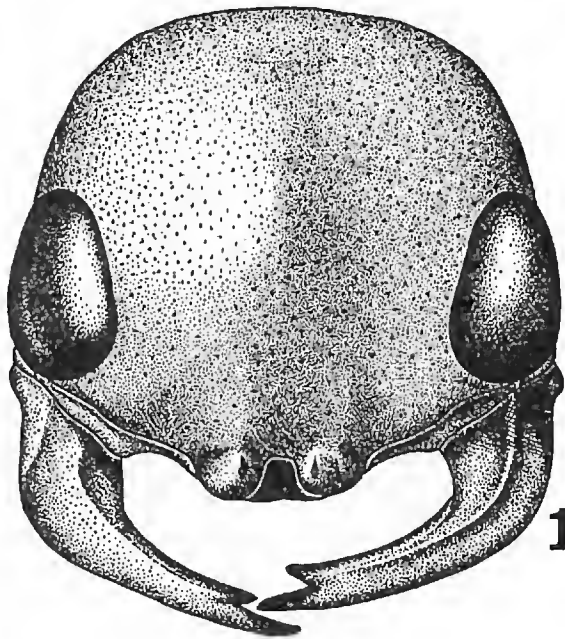
8



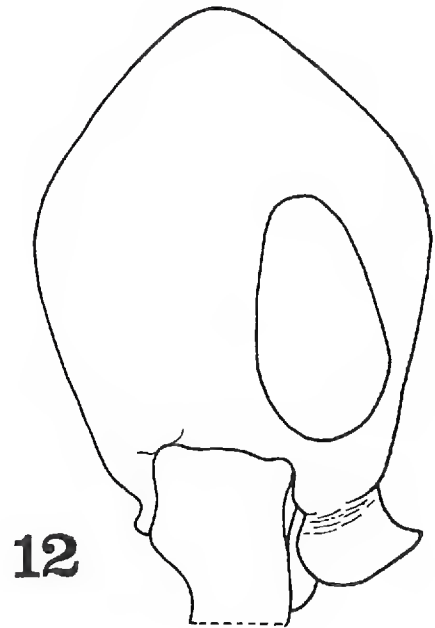
9



10



11



12

collectors (MSW). One female, Vidal Junction, San Bernardino County, California, April 3, 1951, P. D. Hurd collector (CIS). Two females, Gila Bend, Arizona, March 26, 1940, R. H. Crandall collector (USNM). Two females, Tucson, Arizona, May, 1905, Wm. M. Wheeler collector (USNM).

Variation.—Length 3.46–5.22 mm.; pale integumental spots on second metasomal tergum comma-shaped to nearly round. Variation in the shape of these markings is evidently not geographically correlated, as both round and comma-shaped spots occur in population samples taken at Tucson, Arizona.

Dr. R. M. Bohart informs me that the holotype was collected at a mat of *Euphorbia* sp. *M. nasuta* shares with the following species the pronounced median nasutiform lobe which projects above the antennal sockets. It differs primarily in the shape of the lobe which in lateral view curves more strongly posteriorly and in posterior view is apically truncate.

***Myrmosula boharti* Wasbauer, new species**

(Figs. 13, 14)

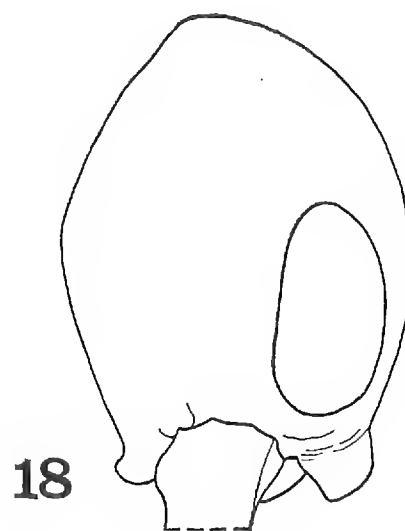
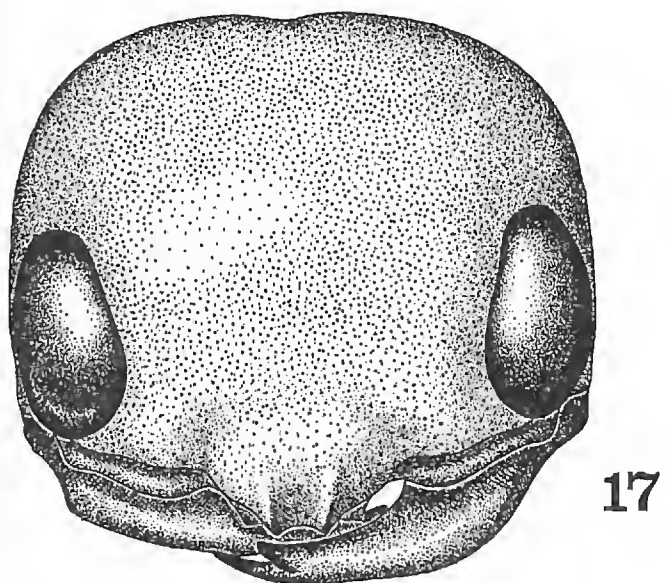
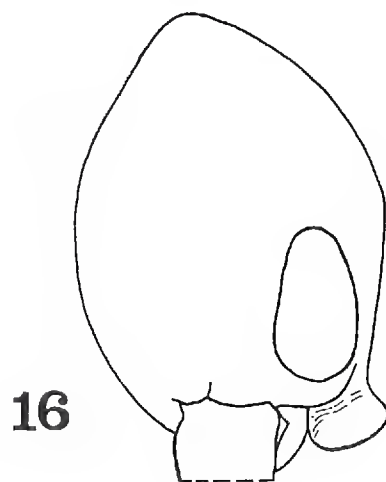
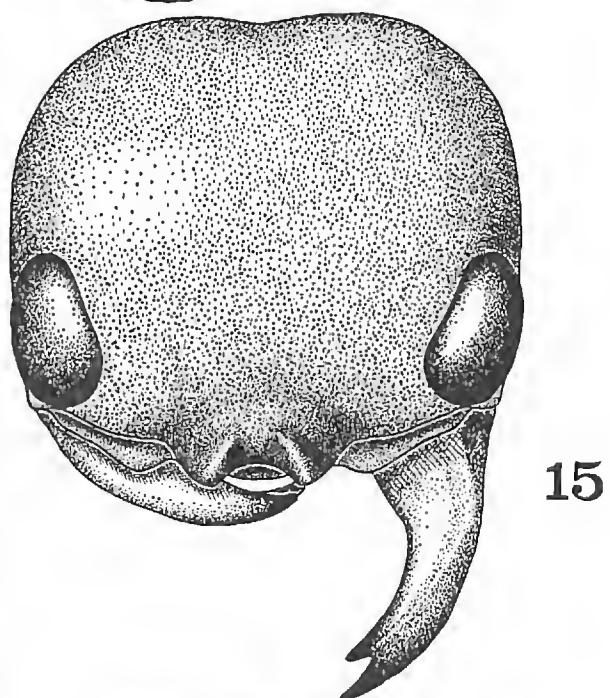
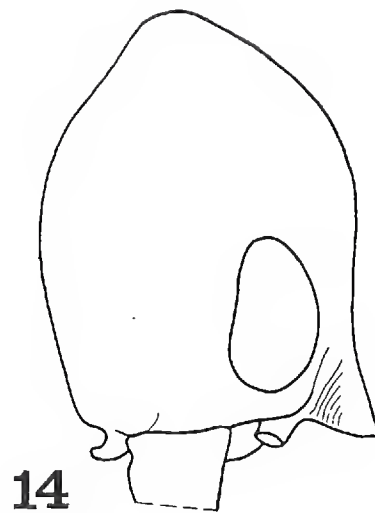
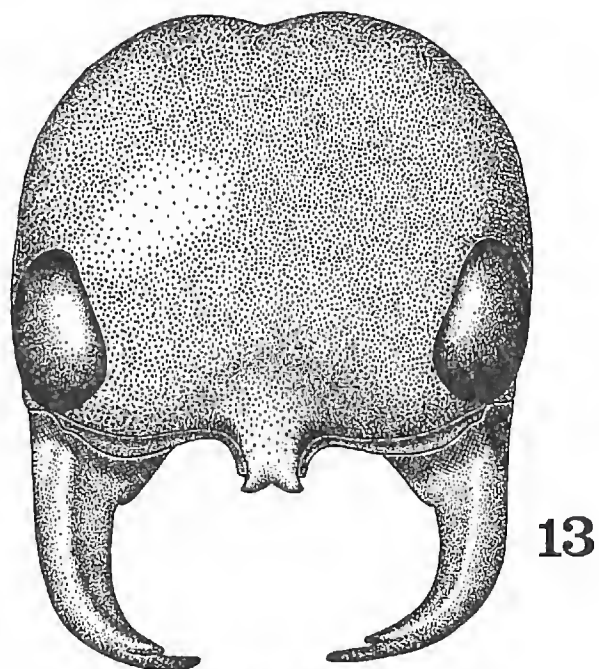
HOLOTYPE FEMALE.—Entirely orange-brown; ultimate tarsal segments darkened; tips of mandibular teeth reddish-black; first through fourth metasomal terga with dark brown apical band, interrupted medially on second; ultimate tergum entirely dark brown; second tergum with pair of anterolateral, creamy white, rounded spots; fifth tergum with medioapical rounded pale spot.

Entire insect shining, punctation minute, punctures on head uniformly small, separated by an average of less than their diameter; on mesosoma, faint, shallow, appearing as reticulations, posterior face of propodeum with a number of larger, shallow, irregular punctures; on metasoma, distinct, separated by slightly more than their diameters. Vestiture consisting of short, shining hairs mostly decumbent on head, mesosoma, first metasomal tergum, and second metasomal sternum, giving these parts distinct dilute sheen in certain lights; slightly longer, erect to suberect on second and succeeding metasomal terga and third and succeeding sterna; scattered, slightly longer, erect hairs over entire body, longest on metasomal sterna, most dense on posterior face of propodeum and first metasomal tergum.

Head.—Frons strongly produced apically into rather narrow nasutiform interantennal elevation, in lateral view wedge-shaped anteriorly, nearly straight dorsally; in dorsal view with two divergent teeth at apex; frons without depressions posterior to interantennal elevation; medioapical margin of clypeus subtruncate, set off from lateroapical margin by small carina; mandibles stout, dorsal tooth subequal to ventral tooth, basal mandibular lamella low, margin flat for most of its length; hypostomal carina produced into very strong, recurved tooth just mesad of posterior mandibular condyle, visible below mandibular lamella.

←

FIGS. 7–12. Heads of female Myrmosinae. Dorsal view on left, right lateral view on right. Figs. 7–8. *Myrmosula nasuta*. Figs. 9–10. *Myrmosula latericarinata*. Figs. 11–12. *Myrmosula peregrinatrix*.



Mesosoma.—Propodeum in dorsal view narrower than pronotum. Width ratios: pronotum 1.00; propodeum 0.910; anterior tarsus with hairs of ventral basitarsal comb equal width of basitarsus at their bases; propodeum without carina near spiracles, posterolateral surfaces smooth.

Length.—4.18 mm.

HOLOTYPE (UCD #795), THOUSAND PALMS, RIVERSIDE COUNTY, CALIFORNIA, April 9, 1964, R. M. Bohart collector. Paratype female, same data, F. D. Parker collector (UCD).

Dr. Bohart informs me that both the holotype and paratype were collected at mats of *Euphorbia* sp.

***Myrmosula latericarinata* Wasbauer, new species**

(Figs. 9, 10)

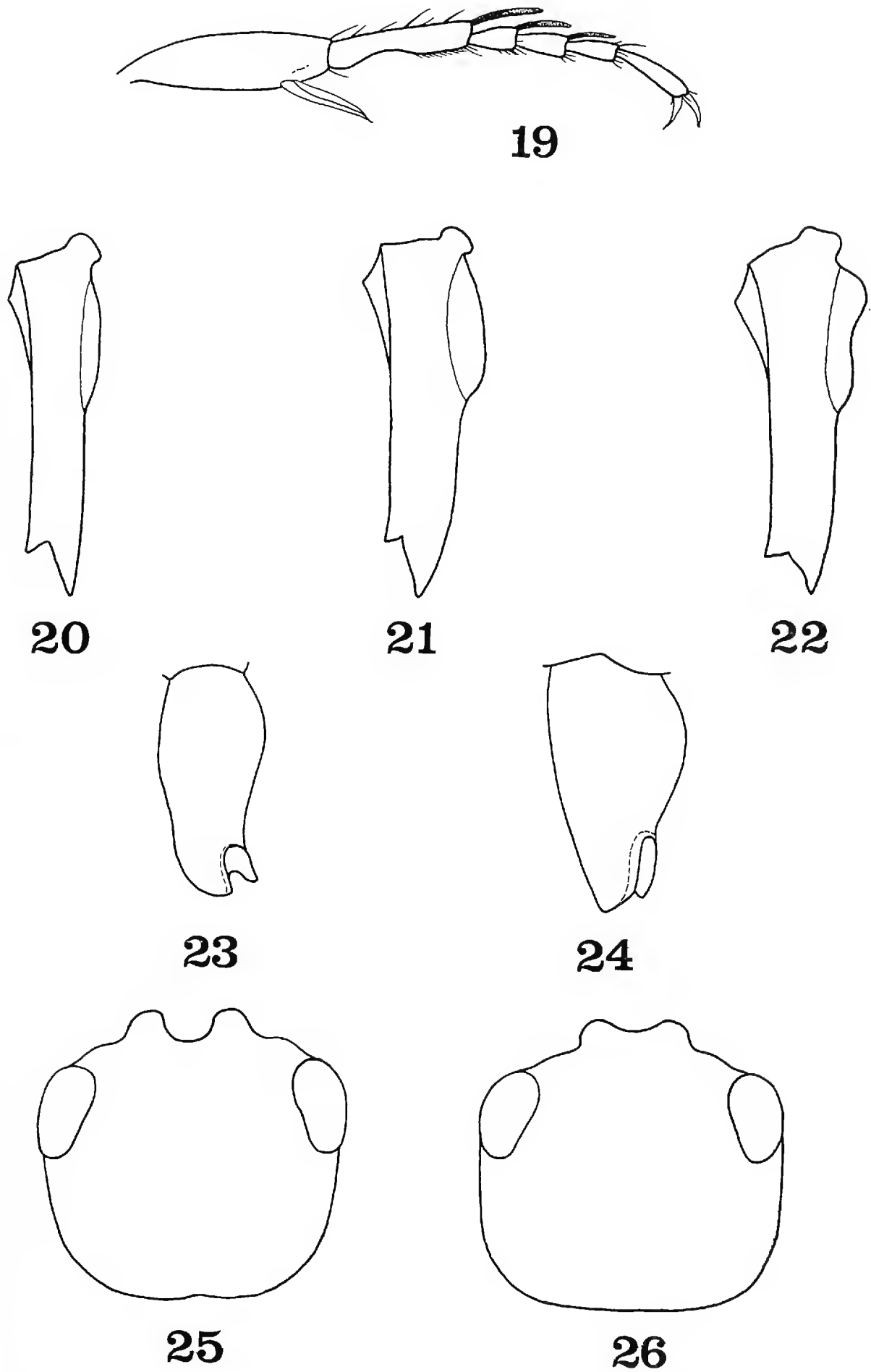
HOLOTYPE FEMALE.—Entirely orange-brown; tips of mandibles reddish-black; ultimate segment of antenna blackish; second and third metasomal terga with dark brown apical band, interrupted medially on second; apical tergum entirely dark brown; second metasomal tergum with pair of poorly defined, anterolateral, cream-colored spots. Entire insect mat to subshining, punctation minute, punctures on head separated by less than their diameter except narrow median band on frons; on disc of pronotum, slightly larger, separated by about their diameter; on mesonotum, separated by less than their diameter; on mesepisternum, very small, shallow, scattered, merging with reticulation; on posterior face of propodeum, sparse with scattered larger punctures; on metasomal segments, small distinct, separated by about or slightly more than their diameter. Vestiture consisting of very short, decumbent to longer, erect hairs giving distinct sheen in certain lights to head, mesosoma and parts of metasoma; erect hairs numerous, very short on head and dorsum of mesosoma, longer on occiput, anterior, declivous face of pronotum, posterior face of propodeum, first metasomal segment; scattered on succeeding metasomal sterna; scattered on coxae and femora ventrally.

Head.—Frons produced apically into low, rounded projection, in dorsal view, broadly bilobed at apex, in lateral view rounded, not strongly projecting dorsally; without dimple-like depressions posterior to projection; medioapical margin of clypeus slightly concave, distinctly angled at junction with lateroapical margin; mandibles stout, dorsal tooth weak, much shorter than ventral tooth; basal mandibular lamella relatively high, emarginate at broad, shallow notch; occipital carina present, well developed, not curving toward midline of head anteriorly; hypostomal carina produced into broad, rounded elevation mesad of posterior mandibular condyle, visible below mandibular lamella.

Mesosoma.—Pronotum with short dorsal surface and nearly vertical anterior declivity; mesonotum margined by sharp lateral angulation extending to propodeal spiracle; propodeum margined by lateral carina terminating in low tooth pos-

←

FIGS. 13–18. Heads of female Myrmosinae. Dorsal view on left, right lateral view on right. Figs. 13–14. *Myrmosula boharti*. Figs. 15–16. *Myrmosula rutilans*. Figs. 17–18. *Myrmosula pacifica*.



FIGS. 19-26. Taxonomic characters of female Myrmosinae. Fig. 19. Left anterior tibia and tarsus, *Leiomyrmosa spilota*. Figs. 20-22. Lateral view, left

teriorly; propodeum in dorsal view narrower than pronotum. Width ratios: pronotum 1.00; propodeum 0.966; anterior tarsus with hairs of ventral basitarsal comb about half width of basitarsus at their bases.

Length.—4.84 mm.

HOLOTYPE (CAS #11897), LANITO, BAHIA CONCEPCION, TERRITORIO SUR DE BAJA CALIFORNIA, April 16, 1968, M. E. Irwin collector. Paratype female, 25 miles south Santa Rosalia, April 15, 1968, 200', dry wash, M. E. Irwin collector (UCR). The holotype has been placed on indefinite loan to the California Academy of Sciences from the collection of the University of California at Riverside.

KEY TO NEARCTIC GENERA OF FEMALE MYRMOSINAE

1. Clypeus with median spine or tooth; first metasomal sternum with large, conspicuous tooth or lamella; ocelli usually present; forms with heavy punctation and sculpture *Myrmosa*
 Clypeus simple; first metasomal sternum simple or with only very small, inconspicuous tooth; ocelli absent; relatively smooth forms without heavy punctation or sculpture 2
2. Mandibles with large apical tooth and two very small, low teeth on inner margin (fig. 1); ventral mandibular lamella absent; anterior tarsus with rake consisting of long, spatulate spine at outer apex of each segment (fig. 19); anterior coxa without tooth at apex (fig. 23) *Leiomyrmosa*
 Mandibles with two apical teeth (figs. 3, 5); ventral mandibular lamella present (figs. 20, 21, 22); anterior tarsus without rake; anterior coxa usually with at least small tooth at anterior apex (fig. 24) *Myrmosula*

KEY TO NEARCTIC SPECIES OF FEMALE MYRMOSULA

1. Antennal tubercles completely separated, frons between their bases not raised above remainder of frons (figs. 3, 11, 25) 2
 Antennal tubercles more or less fused into single interantennal elevation (figs. 5, 15); if bilobed, frons between base of lobes raised above remainder of frons (fig. 26) 3
2. Antennal tubercles separated by distance less than their basal width, each with small tooth posteriorly (figs. 11, 12) *peregrinatrix* Krombein
 Antennal tubercles separated by distance equal their basal width, rounded posteriorly (figs. 3, 4) *parvula* (Fox)
3. Mesonotum margined by sharp lateral angulation; propodeum with raised dorsolateral carina continuous with spiracle, terminating posteriorly in distinct tooth; interantennal elevation low, rounded, without teeth or ridges (figs. 9, 10) *latericarinata* Wasbauer
 Mesonotum not margined; propodeum sometimes with small posterolateral

←

mandible of *Myrmosula* females. Fig. 20. *M. nasuta*. Fig. 21. *M. rutilans*. Fig. 22. *M. exaggerata*. Figs. 23–24. Left anterior coxa of female Myrmosinae. Fig. 23. *Leiomyrmosa spilota*. Fig. 24. *Myrmosula rutilans*. Figs. 25–26. Heads of *Myrmosula* females, posterior view. Fig. 25. *M. parvula*. Fig. 26. *M. rutilans*.

- tooth but without raised dorsolateral carina continuous with spiracle; interantennal elevation with low ridges dorsally or teeth at apex (figs. 13, 17) ... 4
4. Interantennal elevation strongly produced into nasutiform projection (figs. 7, 13); inferior margin of mandibular lamella evenly convex or nearly straight (fig. 20); anterior tooth of hypostomal carina distinct, recurved, visible below mandibular lamella when mandibles closed (figs. 8, 14) 5
- Interantennal elevation not as strongly produced; either a) inferior margin of mandibular lamella emarginate (or highest near base) (fig. 22) or b) anterior tooth of hypostomal carina absent or very small, not visible below mandibular lamella when mandibles closed (fig. 16) 6
5. In lateral view (fig. 14), interantennal elevation slender, wedge-shaped, anterior margin nearly straight; in posterior view, with two divergent apical teeth; at least indication of occipital carina present *boharti* Wasbauer
In lateral view (fig. 8), interantennal elevation stout, not wedge-shaped, anterior margin strongly curved; in posterior view, truncate with two small apical carinae; no indication of occipital carina present *nasuta* Wasbauer
6. Interantennal elevation with pair of pronounced ridges, convergent posteriorly, apex of elevation in dorsal view terminating above bases of antennae (fig. 15), inferior margin of mandibular lamella evenly convex (fig. 21) *rutilans* (Blake)
Interantennal elevation with pair of low, parallel ridges, apex of elevation extending between bases of antennae (figs. 5, 17); inferior margin of mandibular lamella broadly, shallowly emarginate or highest near base at broad angle (fig. 22) 7
7. Parallel ridges of interantennal elevation widely separated, distance between them nearly equal their length (fig. 17) *pacifica* Mickel
Parallel ridges of interantennal elevation more closely spaced, distance between them equal to about half their length (fig. 5) *exaggerata* Krombein

It seems likely that *Myrmosula pacifica* Mickel will prove to be a synonym of *M. exaggerata* Krombein. I have examined, in addition to the holotypes of both nominal species, a number of specimens from southern and central California localities. The only one which will run satisfactorily to *pacifica* in Mickel's key is a topotypic specimen collected by J. W. MacSwain on September 9, 1952. Even this specimen exhibits a very slight emargination on the inferior margin of the mandibular lamella. The majority of central California specimens have the ridges on the interantennal elevation more widely spaced than do the southern California specimens but the great majority have an emargination on the inferior margin of the mandibular lamella. Nearly all specimens examined have a depression on the frons, posterior to the interantennal elevation, including the holotype of *exaggerata*. Despite these considerations, however, the name *Myrmosula pacifica* Mickel should be retained until more information is available on interpopulation variation.

LITERATURE CITED

- BLAKE, C. A. 1879. Catalog of the Mutillidae of North America with descriptions of new species. *Trans. Amer. Entomol. Soc.*, 7: 243-254.
- BRADLEY, J. C. 1917. Contributions toward a monograph of the Mutillidae and their allies of America north of Mexico. IV. A review of the Myrmosidae. *Trans. Amer. Entomol. Soc.*, 43: 247-290, 6 pl.
- FOX, W. J. 1899. The North American Mutillidae. *Trans. Amer. Entomol. Soc.*, 25: 219-292.
- KROMBEIN, K. V. 1940. Studies in the Tiphidae (Hymenoptera: Aculeata). IV. A revision of the Myrmosinae of the new world with a discussion of the old world species. *Trans. Amer. Entomol. Soc.*, 65: 415-465.
1946. A new species of *Myrmosa* (Hymenoptera: Tiphidae). *Proc. Entomol. Soc. Wash.*, 48(9): 247-248.
- MICKEL, C. E. 1940. The identification of the female of the myrmosid subgenus *Myrmosula* (Hymenoptera: Tiphidae). *Pan-Pac. Entomol.*, 16(3): 132-134.
- WASBAUER, M. S. 1968. New genera of male Brachycistidinae with a redescription of *Brachycistellus* Baker and a key to North American genera (Hymenoptera: Tiphidae). *Pan-Pac. Entomol.*, 44(3): 184-197.

SCIENTIFIC NOTE

New distribution and host record for the parasitoid *Heteroschema aeneiventris* (Hymenoptera: Pteromalidae)—Intensive collecting during 1971 and 1972 at Pescadero State Beach, San Mateo County, California has resulted in the discovery of a species of chalcid not previously known from the state. This is the first report of *Heteroschema aeneiventris* (Ashmead) in California and its parasitism of *Euaestoides acutangulus* (Thomson) (Diptera: Tephritidae), whose larvae destroy the staminate florets of beach bur, *Ambrosia chamissonis* (Lessing) Greene (Compositae), a prominent member of the coastal strand and dune community. The discovery of the parasitoid in the state is of particular interest because its previously known range in the United States was limited to Kansas (Peck, 1963, *Can. Entomol. Suppl.* 30: 629), Montana (Novak, 1967, Unpubl. M.S. Thesis, Kent State Univ., 102 pp.), New Mexico, Texas and Utah (Burks, per. commun.). The only other recorded host is the tephritid *Neotephritis finalis* (Loew) (Novak, loc. cit.).

Laboratory investigation has shown *H. aeneiventris* to be a primary, internal, solitary larval-pupal parasitoid. Of 460 field-collected *E. acutangulus* puparia, 40% were parasitized by this chalcid. The wasp is bivoltine in coastal California, with peak emergence periods in mid-July and mid-September.

The writer is indebted to Dr. B. D. Burks, U. S. N. M., Washington, D. C., for the identification of the parasitoid and to the California Department of Parks and Recreation for permission to collect at the designated area.—GARY L. PIPER, *Department of Entomology and Parasitology, University of California, Berkeley, 94720.*

New Species of *Eburia* from Mexico

(Coleoptera: Cerambycidae)

JOHN A. CHEMSAK AND E. G. LINSLEY

*Division of Entomology and Parasitology
University of California, Berkeley 94720*

Thirty-two species of *Eburia*, exclusive of those described here, are presently known from North America, Mexico and Central America. Of these, eleven occur in the United States (Linsley, 1962) (only four of these have not yet been found in Mexico) and twenty-eight in Mexico and Central America (Bates, 1879–1885; Chemsak and Linsley, 1970a) (including seven of those which extend their range into the United States). The West Indies, including the Lesser Antilles, contains twenty-eight known species, one of which, *E. stigma* (Olivier) is widespread in Mexico and southeastern United States. The remaining species occur in South America, extending into Argentina.

The object of the present paper is to make known some of the many undescribed species in Mexico in order that the names may be available for use in biogeographical and, hopefully, behavioral studies. One such study (Chemsak and Linsley, 1970b) has revealed a remarkable death-feigning behavior in two species presently assigned to the genus, *E. ulkei* Horn and *E. juanita* Chemsak & Linsley.

Appreciation is expressed to the National Science Foundation for support through Grant GB-4944X and to Celeste Green for preparing the illustrations.

***Eburia affluens*, new species**

(Fig. 1)

MALE: Form moderate sized, slightly tapering posteriorly; integument brownish, antennal scape and legs orange-brown, mouthparts, pronotal calluses, a narrow line around eburneous fasciae, apices of antennal segments, apices of femora, and parts of coxae black or infuscated; pubescence of elytra sericeous, short, appressed, short erect hairs numerous interspersed; eburneous fasciae cream-colored, contiguous, basal pairs equal in length, outer median pair longer than inner, inner pair longer than basal pairs. Head small, median line deep, extending to neck; palpi subequal, not dilated; genae short, obtuse at apices; antennal tubercles depressed, not prominently produced, apices acute but blunt; pubescence dense, appressed; antennae slender, extending about five segments beyond apices of elytra, scape conical, not impressed, coarsely, not densely punctate, sparsely pubescent, segments two to six moderately densely pubescent, remainder densely clothed with short recumbent pubescence, segments to sixth fringed beneath with long erect hairs, these decreasing in number from basal segments, segments from sixth carinate along inside edges, third segment much longer than first, fourth equal to third, fifth longer than third, eleventh longest, slender, third

segment finely rugosely punctate. Pronotum as long as broad, sides with a small acute tubercle; lateral calluses behind apex large, dorsal tubercles prominent, middle with a flat callus toward base; punctures coarse, dense, confluent; pubescence dense, appressed, obscuring surface; prosternum deeply impressed, coarsely, deeply punctate over posterior two-thirds, pubescence dense, intercoxal process abruptly declivous, coxal cavities open behind; meso- and metasternum finely, densely punctate, densely pubescent, scent glands distinct. Elytra about two and one-half times as long as broad; eburneous fasciae sparsely pubescent; each elytron vaguely bicostate between fasciae; punctures moderately coarse, dense, becoming finer toward apex; pubescence obscuring surface, golden erect hairs short; apices emarginate, outer angles with a curved spine, sutural angles with a short straight spine. Legs robust; hind femora reaching almost to apices of elytra; middle and hind femora with a moderate sized broad spine internally at apices, outside with a short broad tooth. Abdomen finely punctate, densely pubescent; last sternite shallowly notched at apex. Length, 14–26 mm.

FEMALE: Form similar. Antennae a little longer than body. Elytra with erect pubescence much longer. Abdomen with last sternite narrowly rounded at apex, notched at middle. Length, 17–25 mm.

HOLOTYPE MALE, allotype (California Academy of Sciences) and 60 paratypes (35 males, 25 females) from X-CAN, QUINTANA ROO, MEXICO, various dates from 9 June to 16 July 1967, 10 April to 29 May 1968, 10 March 1969 (E. C. Welling), 5–7 June 1959 (P. & C. Vaurie).

E. affluens is somewhat similar to *E. brevispinis* Bates but may be separated by the equal, contiguous basal elytral fasciae, the shorter contiguous median fasciae, the coarsely punctate and more densely pubescent pronotum, and the more densely punctate elytra. Variation in this species, in addition to the sexual differences, primarily involves size and coloration. A number of specimens have a testaceous rather than darker brown integument. The eburneous fasciae of the elytra are well developed in all individuals and are similar in size and shape throughout.

***Eburia brevicornis*, new species**

(Fig. 2)

MALE: Form moderate sized, parallel; integument reddish-brown, appendages rufo-testaceous; elytral eburneous fasciae yellowish, distinct, each pair contiguous, each fascia about as broad as apex of third antennal segment, basal pair subequal in length, shorter than scape, median pair with outer longer than inner, outer longer than scape; pubescence fine, grayish, appressed, partially obscuring surface. Head small, front very deeply impressed; median line deep, extending onto neck; palpi subequal, apical segments dilated; vertex small, median line becoming a carina; antennal tubercles depressed, obtuse above; pubescence dense appressed; antennae extending about two segments beyond elytra, segments five to ten slightly produced at apices, scape sparsely pubescent, not impressed, coarsely punctate, segments three and four moderately densely clothed with short appressed pubescence, remaining segments subopaque, densely clothed with very short depressed pubescence, basal segments with numerous long erect hairs be-

neath, becoming sparser to sixth segment, absent on apical segments, third segment longer than first, fourth shorter than third but longer than first, fifth longer than fourth, eleventh longer than tenth, appendiculate. Pronotum about as long as broad, sides vaguely tuberculate; disk with two prominent, glabrous, black calluses before middle, two flat glabrous calluses present at sides behind apical margin; surface irregular, rugose, punctures transverse; pubescence dense, appressed, with long erect hairs interspersed; prosternum deeply impressed, coarsely, rugosely punctate over posterior two-thirds; pubescence dense, prosternal process abruptly declivous, apex not expanded, coxal cavities open behind, rounded externally; meso- and metasternum finely densely punctate, densely pubescent, scent glands obvious. Elytra about two and one-half times as long as broad; eburneous fasciae with a few erect setae; each elytron usually bicostate between fasciae; punctures around basal fasciae coarse, contiguous, coarse punctures scattered over surface, especially near median fasciae; pubescence appressed, dense, except around fasciae, long erect setae rising out of coarse punctures; apices emarginate truncate, outer angles with a short tooth, sutural angles with a very acute tooth. Legs slender; posterior femora not attaining elytral apices; middle and hind femora spinose internally at apex, spines much longer than those of elytra. Abdomen very finely, densely punctate, moderately densely pubescent; last sternite broadly rounded at apex. Length, 14–20 mm.

FEMALE: Form similar. Antennae shorter than body, basal segments with long, erect hairs beneath and at sides. Abdomen with last sternite rounded at apex. Length, 20–22 mm.

HOLOTYPE MALE, allotype (California Academy of Sciences) and 25 paratypes (23 males, 2 females) from X-CAN, QUINTANA ROO, MEXICO, 11–16 June 1967, 29–31 May 1967, 5–29 May 1968, 5–26 June 1968 (E. C. Welling); 3 male paratypes from Piste, Yucatan, Mexico, 16 May to 21 June 1968 (E. C. Welling).

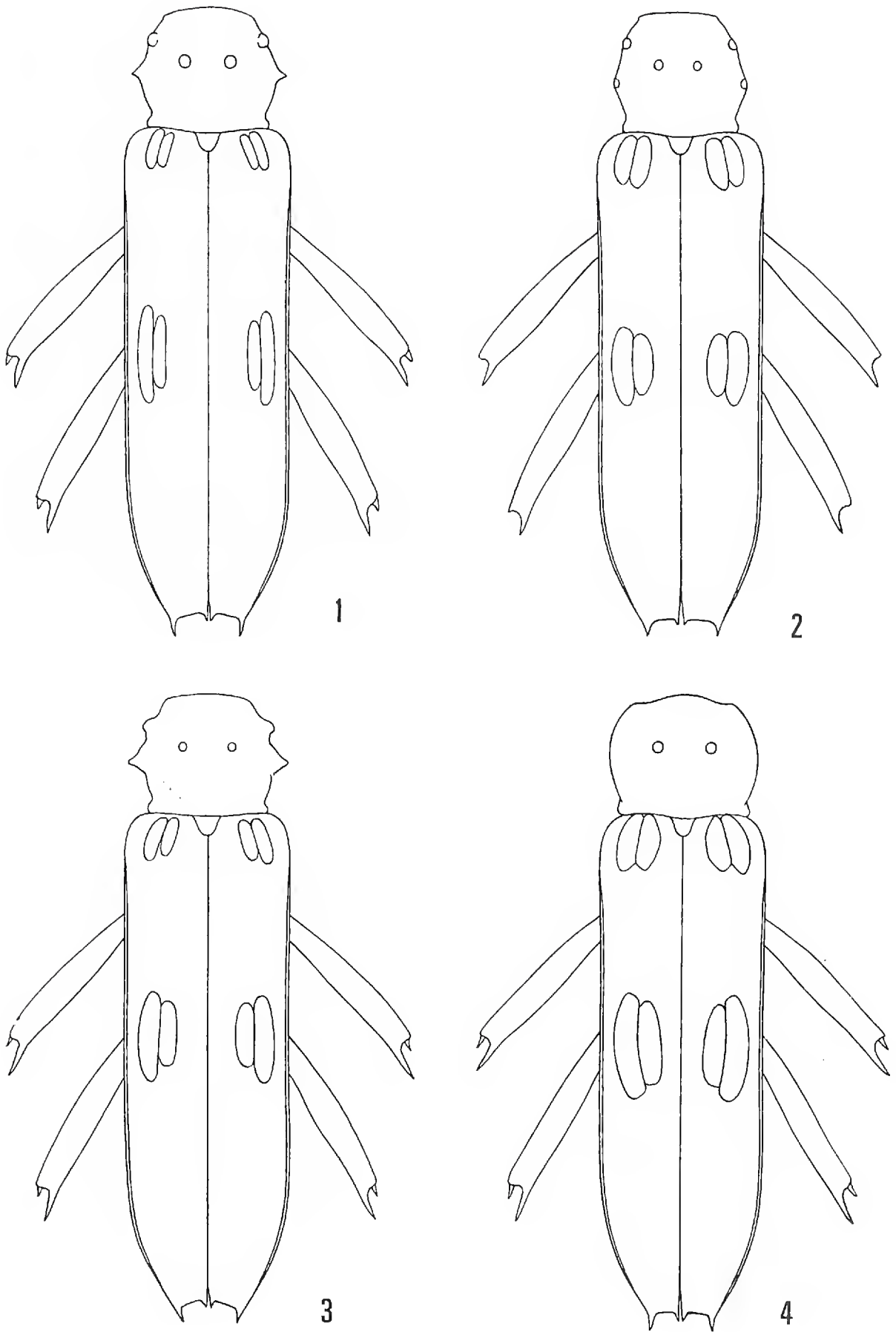
This species somewhat resembles *E. aegrota* Bates but may be readily separated by the presence of the post-apical marginal calluses of the pronotum and the externally produced antennal segments. Additionally, the integument of *aegrota* is paler.

The only obvious variation within the type series is in size. The eburneous fasciae are uniform throughout and characteristics of pubescence and coloration appear similar in all specimens.

***Eburia brunneicomis*, new species**

(Fig. 3)

FEMALE: Form rather large, robust, parallel; integument dark reddish brown, appendages rufo-testaceous, mouthparts, pronotal calluses, antennal tubercles, apices of basal antennal segments, apices of femora, and trochanters black; pubescence very dense, appressed, brownish, obscuring surface, erect hairs numerous; eburneous fasciae yellowish, ringed with black, basal pair contiguous, outer slightly longer, both much shorter than antennal scape, median pair contiguous, outer pair longer than scape, inner pair slightly longer than outer basal pair. Head rather small, front deeply impressed; median line deep, becoming a carina on vertex which extends to neck; palpi unequal, apical segments large



FIGS. 1-4. Diagrammatic illustrations (not scaled) of the pronotum, elytra and middle and hind femora of: Fig. 1. *Eburia affluens* Chemsak & Linsley. Fig. 2. *E. brevicornis* Chemsak & Linsley. Fig. 3. *E. brunneicomis* Chemsak & Linsley. Fig. 4. *E. elegans* Chemsak & Linsley.

but not dilated; genae very acute at apices when viewed from above; antennal tubercles depressed, acute above; pubescence very dense, appressed, long erect hairs interspersed; antennae extending about two segments beyond apices of elytra, segments from fifth slightly flattened, scape sparsely pubescent, not impressed, moderately coarsely, densely punctate, second and third segments more densely pubescent than scape, outer segments very densely clothed with short appressed pubescence, scape with long erect hairs more numerous beneath, segments to eighth with numerous long hairs beneath, these becoming less numerous from basal segments, long, erect hairs also present on outside of basal segments, third segment longer than scape, fourth shorter than third, longer than first, fifth slightly shorter than third, eleventh slightly longer than tenth, vaguely appendiculate. Pronotum about as broad as long, sides with a large blunt spine at middle and an obtuse tubercle behind apex; disk with two prominent blunt tubercles before middle and a vague flattened callus at middle extending back toward base; surface coarsely rugose; pubescence obscuring surface except on calluses; prosternum deeply impressed, coarsely, deeply punctate over basal two-thirds, pubescence dense, intercoxal process abruptly declivous, apex not expanded, coxal cavities open behind; meso- and metasternum minutely, densely punctate, very densely clothed with short appressed pubescence, scent glands obvious. Elytra about two and one-half times as long as broad; eburneous fasciae with a few erect setae; basal punctures coarser especially around fasciae, punctures becoming finer and sparser toward apex, well separated; short appressed pubescence obscuring surface, long erect hairs numerous, longer at base and apex; apices truncate, each bispinose, outer spine longer than inner, shorter than femoral spines. Legs slender; posterior femora not attaining elytral apices; middle and hind femora with long spines internally at apices, outer spines very short, as long as third tarsal segment. Abdomen very finely densely punctate, densely pubescent; last sternite rounded at apex. Length, 21-30 mm.

MALE: Form similar. Antennae extending about three segments beyond elytra. Abdomen with last sternite broadly rounded at apex. Length, 23 mm.

HOLOTYPE FEMALE, allotype (California Academy of Sciences) and 6 female paratypes from X-CAN, QUINTANA ROO, MEXICO, 15 June to 26 July 1967 (E. C. Welling); 5 paratypes (1 male, 4 females) from Piste, Yucatan, Mexico, 16 June to 20 July 1967 (E. C. Welling).

This species differs from *E. pedestris* White by the thicker brownish pubescence, the black-ringed elytral fasciae, non-impressed antennal scape, and by the short outer spines of the femora. From *E. championi* it is distinguished by the non-impressed antennal scape, the denser pubescence, the more numerous erect hairs of the elytra, and the shorter spines of the elytra. The combination of dense brownish pubescence and black-ringed eburneous fasciae makes *E. brunneicomis* easily recognizable.

***Eburia elegans*, new species**

(Fig. 4)

MALE: Form large, robust; integument reddish, appendages orange; eburneous fasciae yellowish, broad, contiguous, basal pairs subequal in length, about twice

as long as broad, outer median pair longer than inner, inner longer than basal pairs; pubescence white, very short, dense, appressed, long erect hairs golden, not numerous. Head small, front deeply impressed; median line deep, extending to neck; palpi subequal, apical segments slender; genae acute at apex; antennal tubercles small, apices bluntly produced; pubescence dense, appressed, yellowish; antennae slender, elongate, about twice as long as body, scape small, cylindrical, narrowly impressed above, coarsely, densely punctate, sparsely pubescent, segments from third densely clothed with short appressed pubescence, long erect hairs dense beneath on basal segments, becoming sparser toward apex, third segment almost twice as long as first, fourth equal to third, fifth longer than third, eleventh very long, slender. Pronotum inflated, broader than long, sides rounded, unarmed; disk with two small black, glabrous tubercles before middle; middle transversely, rugosely punctate, sides very deeply, coarsely, subconfluently punctate; pubescence dense, short, appressed, long erect hairs sparsely interspersed; prosternum not impressed, coarsely, deeply punctate, densely pubescent, intercoxal process abruptly declivous, tuberculate, coxal cavities open behind; meso- and metasternum minutely, densely punctate, densely clothed, with appressed pubescence, scent glands obvious. Elytra more than two and one-half times as long as broad; eburneous fasciae very sparsely pubescent; punctures fine with large seta-bearing punctures interspersed; pubescence dense, appressed, obscuring surface, long, golden hairs sparsely interspersed; apices truncate, bispinose, outer spine longer than inner. Legs very slender; posterior femora reaching to about elytral apices; middle and hind femora bispinose at apices, inner spines much longer. Abdomen densely pubescent; last sternite truncate at apex. Length, 35 mm.

HOLOTYPE MALE (California Academy of Sciences) from X-CAN, QUINTANA ROO, MEXICO, 27 May 1968 (E. C. Welling).

This species is distinctive among the known Mexican and Central American *Eburia* by the inflated, non-tuberculate pronotum.

***Eburia inarmata*, new species**

(Fig. 5)

MALE: Form rather small, parallel; integument shining, pale reddish brown, legs reddish, antennae almost black from third segment, area around median fasciae infuscated; eburneous fasciae creamy, basal pairs narrowly separated, outer longer than inner, median pairs contiguous, outer longer, both longer than basal pairs. Head small, front deeply impressed; median line deep, extending onto vertex; palpi subequal, apical segments slightly dilated; genae acute at apices; antennal tubercles depressed, not produced apically; pubescence dense, recumbent; antennae extending about two segments beyond elytra, scape slender, conical, rather finely, densely punctate, sparsely pubescent, segments from third flattened, produced at apices, second and third segments sparsely pubescent, remainder densely clothed with short appressed pubescence, basal segments with very few erect hairs beneath, third segment a little longer than first, fourth equal to first, fifth equal to third, eleventh longest, appendiculate. Pronotum as long as broad, sides broadly angulate, unarmed; post apical lateral calluses absent; disk with two prominent glabrous, very obtuse tubercles, areas behind tubercles and toward sides impressed; punctures moderately coarse, dense, except for

median glabrous area extending toward base; pubescence dense, recumbent; prosternum narrowly impressed, deeply punctate, densely pubescent, intercoxal process abruptly declivous, coxal cavities open behind; meso- and metasternum finely, densely punctate, densely pubescent, scent pores distinct. Elytra about three times as long as broad; eburneous fasciae sparsely pubescent; basal punctures coarse, confluent, becoming very fine and irregular toward apex; pubescence dense, subrecumbent, obscuring surface partially except at base and around median fasciae, erect hairs sparse; apices obliquely truncate, inner angles with small spine. Legs slender; hind femora not extending beyond apices of elytra; middle and hind femora unarmed at apices. Abdomen finely densely punctate, densely pubescent; last sternite subtruncate at apex. Length, 16 mm.

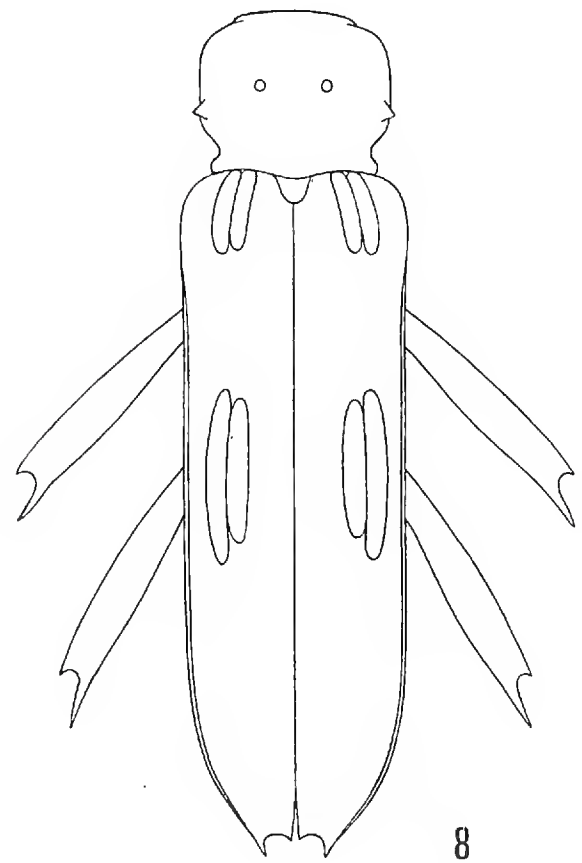
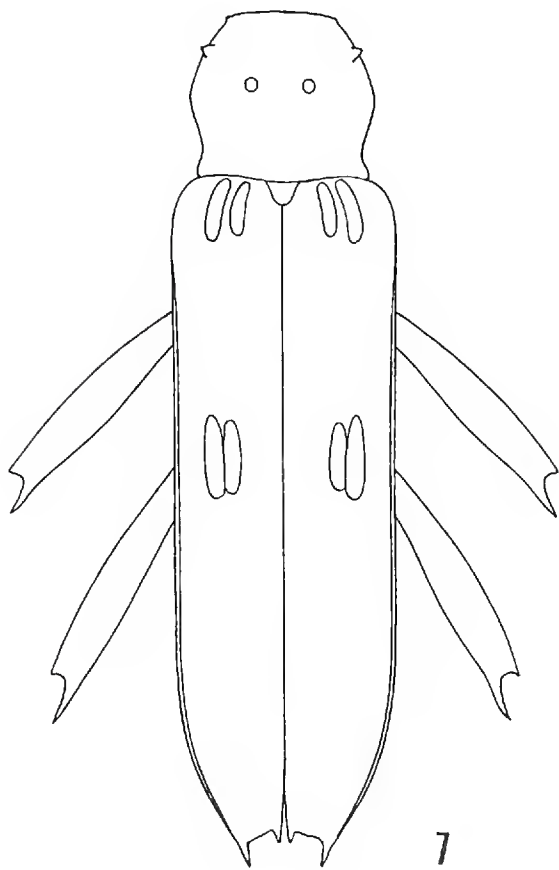
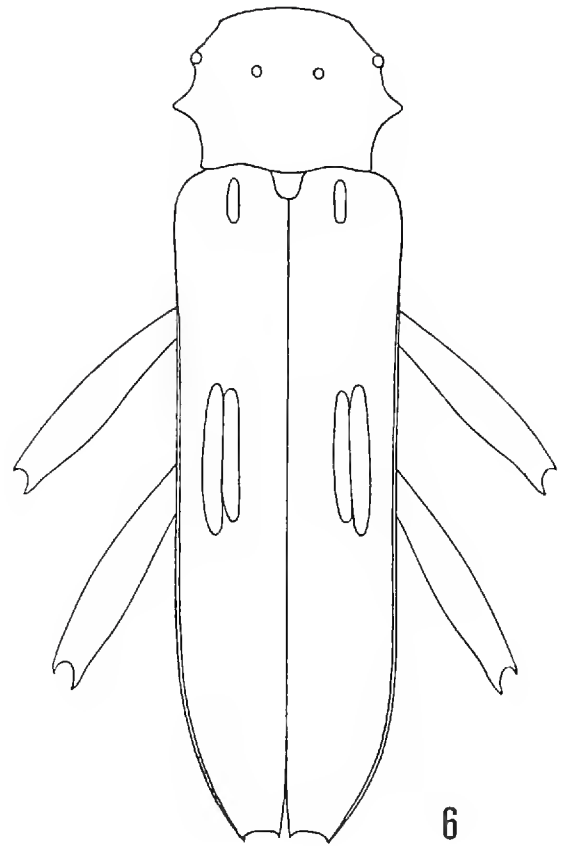
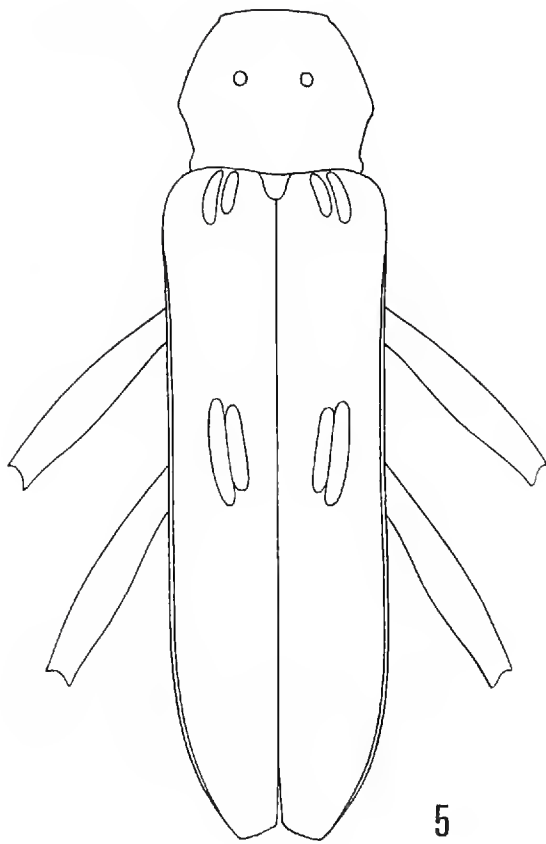
HOLOTYPE MALE (California Academy of Sciences) from 16 MILES S. GUAMUCHIL, SINALOA, MEXICO, 16 June 1961 (F. D. Parker).

This species may be recognized by the very distinctive, flattened antennae, the impressions of the pronotal disk, and the absence of pronotal and femoral spines. The grayish, recumbent pubescence is similar to that of some *Elaphidionini* rather than the typical pubescence of most *Eburia*.

Eburia latispina, new species

(Fig. 6)

MALE: Form moderate sized, parallel; integument reddish brown, parts of head, antennal scape, parts of prothorax, areas around fasciae and parts of femora infuscated; eburneous fasciae yellowish, inner pair only present at base, median pairs contiguous, outer slightly longer, both much longer than basal pair; pubescence fine, very dense, appressed. Head small, front deeply impressed; median line deep, extending to neck; palpi subequal, apical segments slightly dilated; genae acute at apices; antennal tubercles depressed, not produced apically; pubescence dense, appressed; antennae slender, extending about three segments beyond elytra, scape conical, not impressed, moderately coarsely, densely punctate, sparsely pubescent, basal segments sparsely pubescent, segments from sixth more densely clothed with very short appressed pubescence, long, erect hairs numerous beneath basally, becoming sparse toward apex, third segment longer than scape, fourth slightly shorter than third, fifth equal to third, eleventh as long as third. Pronotum broader than long, sides with a large broad acute spine; post-apical calluses at sides prominent; disk with two glabrous tubercles before middle and two vague pubescent calluses at sides behind middle, transverse impression behind apex shallow, one before base narrow; middle somewhat flattened, shallowly rugose, punctures irregular; pubescence appressed, obscuring surface; prosternum deeply impressed, sparsely irregularly punctate, densely pubescent, intercoxal process rounded, coxal cavities open behind; meso- and metasternum minutely, densely punctate, densely pubescent, scent pores distinct. Elytra more than two and one-half times as long as broad; eburneous fasciae sparsely pubescent, connected by vague costae; deep punctures abundant at base, irregularly scattered over remainder and becoming very fine toward apex; pubescence short, appressed, obscuring surface except around fasciae; apices obliquely truncate, inner angles



FIGS. 5-8. Fig. 5. *Eburia inarmata* Chemsak & Linsley. Fig. 6. *E. latispina* Chemsak & Linsley. Fig. 7. *E. megalops* Chemsak & Linsley. Fig. 8. *E. minutivestis* Chemsak & Linsley.

minutely spined, outer angles vaguely dentate. Legs slender; hind femora not attaining elytral apices; middle and hind femora with a short, broad tooth internally. Abdomen finely, densely punctate, densely pubescent; last sternite truncate at apex. Length, 18 mm.

HOLOTYPE MALE (California Academy of Sciences) from JESUS MARIA, NAYARIT, MEXICO, 6 July 1955 (B. Malkin).

This species is distinctive by the large broad lateral spine of the pronotum, the configuration of the pronotal disk, the absence of an outer pair of basal eburneous fasciae, and by the scarcely spinose elytral and femoral apices.

***Eburia megalops*, new species**

(Fig. 7)

MALE: Form moderate sized, rather slender, parallel; integument reddish brown; eburneous fasciae yellowish, basal pairs separated, outer pair slightly longer than inner, median pairs contiguous, outer slightly longer, slightly longer than outer basal pair; pubescence grayish, dense, recumbent. Head rather small, front not deeply impressed; median line deep, extending onto vertex; palpi unequal, apical segments large but not strongly dilated; genae acute at apices; eyes large, upper lobes broad, separated on vertex by less than their width; antennal tubercles depressed, not produced apically; pubescence dense, recumbent; antennae extending about three segments beyond elytra, segments from third flattened, apically produced, scape slender, not impressed, rather finely, densely punctate, sparsely pubescent, remaining segments densely clothed with very short appressed pubescence, segments three and four with very few long hairs beneath, third segment longer than scape, fourth slightly longer than scape, fifth longer than third, eleventh longest. Pronotum about as long as broad, sides irregular, not tuberculate medially; lateral calluses behind apex small, glabrous; disk with two small glabrous tubercles and a vague median one, sides vaguely callused toward base; punctures indistinct, surface uneven; pubescence dense, recumbent, obscuring surface; prosternum deeply impressed, vaguely punctate, densely pubescent, intercoxal process abruptly declivous, coxal cavities open behind; meso- and metasternum minutely, densely punctate, densely pubescent, scent glands distinct. Elytra almost three times as long as broad; fasciae not pubescent; punctures irregular, surface finely rugose; pubescence dense, recumbent, erect hairs lacking; apices obliquely truncate, outer angles with prominent spines, inner with small spines. Legs slender; hind femora almost reaching apices of elytra; middle and hind femora spined internally at apices, spines as long as outer elytral ones, neither spined nor dentate externally. Abdomen finely, densely punctate, densely pubescent; last sternite broadly rounded at apex. Length, 22 mm.

HOLOTYPE MALE (California Academy of Sciences) from TEQUISISTLAN, OAXACA, MEXICO, 5 April 1962 (F. D. Parker, L. A. Stange).

The absence of lateral pronotal tubercles, the large dorsal lobes of the eyes, the flattened antennal segments, and the vague punctation make this one of the most distinctive species of *Eburia*.

Eburia minutivestis, new species

(Fig. 8)

MALE: Form small, slender, parallel; integument reddish brown, legs testaceous, parts of head, prothorax, areas around eburneous fasciae, and parts of sternum infuscated; pubescence very short, appressed, long, golden, erect hairs numerous on elytra; eburneous fasciae yellowish, basal pairs contiguous, equal in length, median pairs contiguous, outer longer, inner longer than basal pairs. Head small, front deeply impressed; median line deep, extending to neck; palpi unequal, apical segments not dilated; genae acute at apices; antennal tubercles flat, not produced apically; pubescence dense, appressed; antennae slender, extending about two segments beyond elytra, scape slender, conical, not impressed, rather finely, densely punctate, very sparsely pubescent, segments to fourth sparsely pubescent, remainder densely clothed with very short, appressed pubescence, third segment moderately densely fringed beneath, fringe decreasing to sixth segment, third segment longer than scape, fourth longer than scape but shorter than third, fifth equal to fourth, eleventh equal to fifth. Pronotum about as long as broad, sides with small acute tubercles; disk with two prominent glabrous tubercles; sides behind middle constricted; surface broadly rugose, sides at apex inflated, very deeply, coarsely, confluent punctate, this area extending partially onto disk near apex and onto prosternum; pubescence fine, not obscuring surface; prosternum not impressed, deeply confluent punctate, sparsely pubescent, intercoxal process abruptly declivous, coxal cavities open behind; meso- and metasternum minutely punctate, densely pubescent, scent glands distinct. Elytra less than three times as long as broad; eburneous fasciae with a few setae; basal punctures coarse, separated, becoming finer toward apex; pubescence minute, appressed, long erect hairs numerous; apices truncate, outer angles with a small recurved spine, inner angles dentate. Legs slender; hind femoral surpassing apices of elytra; middle and hind femora with a long internal spine at apices, these much longer than those of elytra. Abdomen finely densely punctate, densely pubescent; last sternite broadly rounded at apex, notched at middle. Length, 15 mm.

HOLOTYPE MALE (California Academy of Sciences) from COTAXTLA EXPERIMENT STATION, COTAXTLA, VERACRUZ, MEXICO, 28 June 1962 (D. H. Janzen).

The basally impressed and very distinctive lateral punctures of the pronotum and the extremely short pubescence make this species readily recognizable. The punctation of the pronotum and prosternum is reminiscent of species of *Callidium*.

Eburia opaca, new species

(Fig. 9)

MALE: Form large, parallel; integument dull, dark reddish brown, front of head, antennal scape, and legs darker; pubescence very fine, dense, appressed, yellowish; eburneous fasciae white, small, basal pair separated, very small, median pair subcontiguous, outer longer than inner. Head small, median line deep, ending as a broad carina on vertex; palpi subequal, slender, genae acute at apices from above; antennal tubercles prominently produced, impressed up middle, blunt at

apices; pubescence brownish, dense, appressed; antennae slender, extending about five segments beyond elytra, scape cylindrical, short, impressed for about two-thirds its length, rather finely, rugosely punctate, sparsely pubescent, pubescence denser along impression, segments from third densely clothed with short appressed pubescence, segments to sixth with a fringe of rather short hairs beneath, third segment much longer than scape, fourth equal to third, fifth equal to third, eleventh longest, slender. Pronotum broader than long, sides with short, obtuse tubercles, lateral calluses behind apex small; disk with two small blunt tubercles before middle, a vague flattened callus at middle extending toward base and two vague calluses at sides near base; surface densely covered with moderate sized, deep, pock-like punctures around calluses; pubescence around punctures dense, short, recumbent; prosternum impressed, deeply, separately punctate, intercoxal process abruptly declivous, coxal cavities open behind; meso- and metasternum finely densely punctate, densely pubescent. Elytra about two and one-half times as long as broad; eburneous fasciae sparsely pubescent; each elytron bicostate between fasciae and behind median pair toward apex, inner costa turning to suture before apex; punctures obsolete; pubescence short, dense with longer suberect hairs sparsely interspersed; apices narrowly truncate, sutural angles with very short spines, outer angles dentate. Legs slender; hind femora not attaining elytral apices; middle and hind femora bidentate at apices. Abdomen minutely, densely punctate, densely pubescent; last sternite emarginate at apex. Length, 33 mm.

FEMALE: Form similar. Antennae slightly longer than body. Abdomen with last sternite rounded at apex. Length, 23-37 mm.

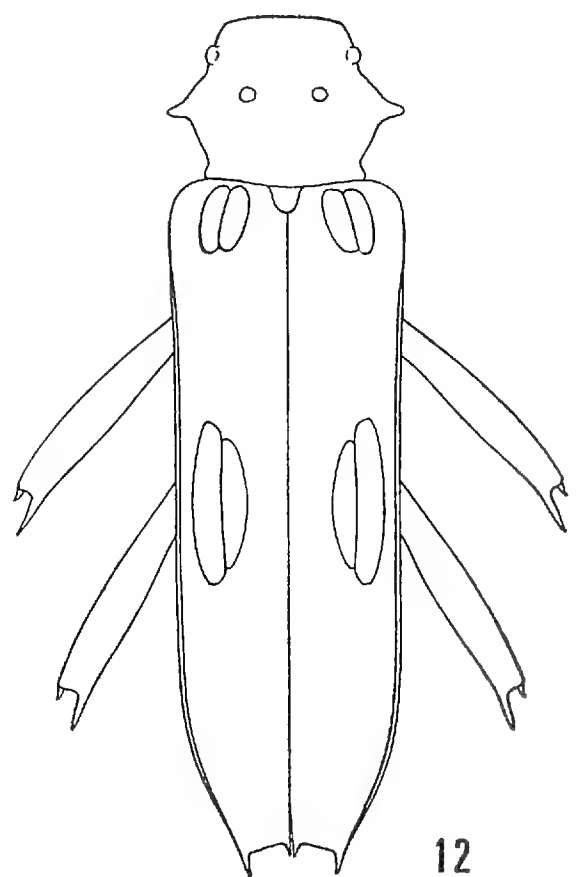
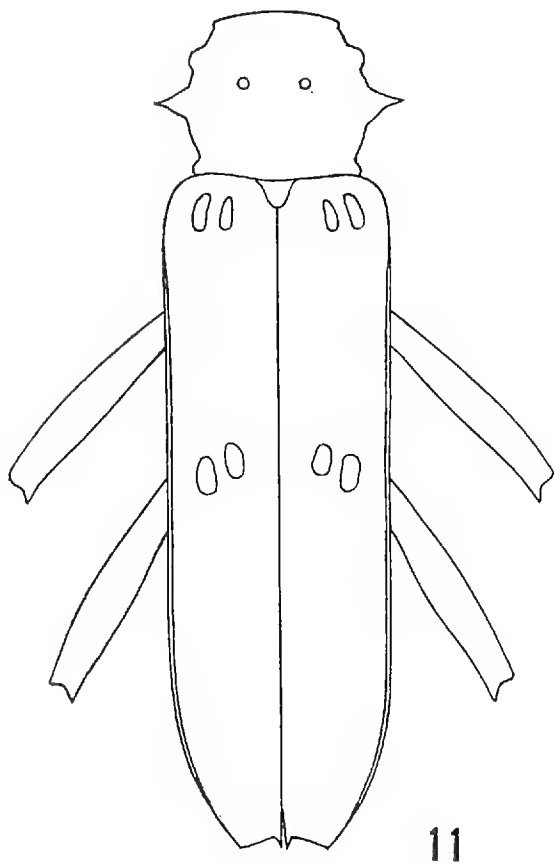
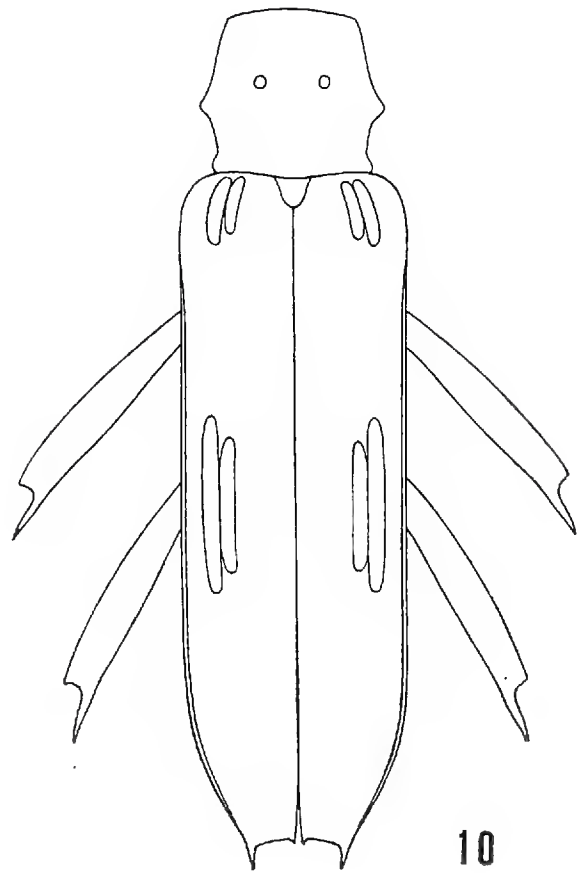
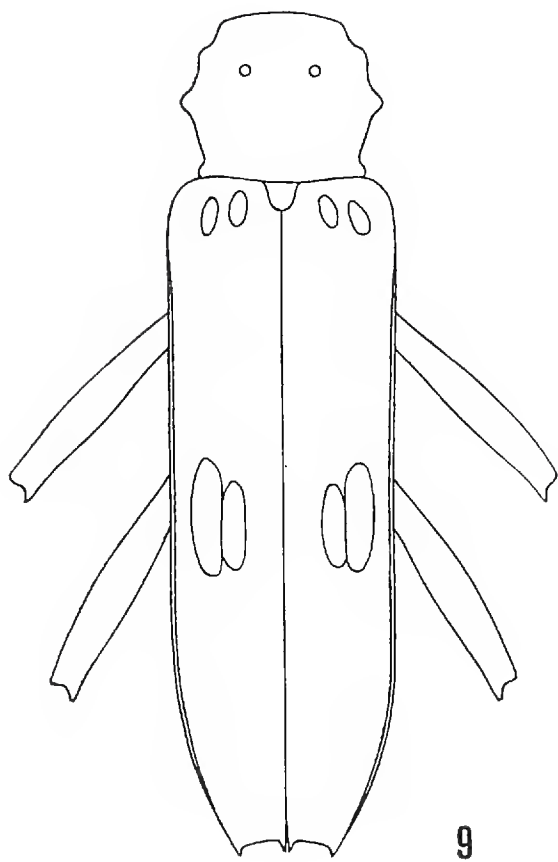
HOLOTYPE MALE, allotype (California Academy of Sciences) and 3 female paratypes from X-CAN, QUINTANA ROO, MEXICO, 2 and 4 May 1968 (E. C. Welling). Two additional female paratypes from Piste, Yucatan, Mexico, 12 June 1967 (E. C. Welling).

This species belongs to the *stigmatica* group but may be separated from the other known species by the more densely punctate pronotum, the very blunt lateral tubercles of the pronotum, the white elytral fasciae and the nearly contiguous median pair of elytral fasciae. The eburneous fasciae tend to be reduced and at least the basal pair will probably prove to be absent in some specimens. The females have minute spines at the sutural angle of the elytra and no spines or dentation at the outer angles.

***Eburia paraegrota*, new species**

(Fig. 10)

MALE: Form small, parallel; integument testaceous, tips of mandibles, eyes, pronotal tubercles and small areas around eburneous fasciae black; pubescence very short, appressed, longer erect hairs sparsely interspersed. Head small, front not deeply impressed; median line deep, extending onto vertex; palpi subequal, apical segments broadened; genae blunt at apices; antennal tubercles depressed, not produced apically; pubescence fine, dense, appressed; antennae slender, extending about four segments beyond elytra, scape slender, conical, not impressed,



FIGS. 9-12. Fig. 9. *Eburia opaca* Chemsak & Linsley. Fig. 10. *E. paraegrota* Chemsak & Linsley. Fig. 11. *E. poricollis* Chemsak & Linsley. Fig. 12. *E. submutata* Chemsak & Linsley.

moderately coarsely, densely punctate, sparsely pubescent, remaining segments moderately densely clothed with very short recumbent pubescence, basal segments with a fringe of long hairs beneath, these becoming less numerous to sixth segment, third segment longer than first, fourth subequal to third, fifth equal to fourth, eleventh longest, slender. Pronotum longer than broad, sides with an acute tubercle behind middle; lateral post-apical calluses absent; disk with two prominent, glabrous tubercles before middle, middle vaguely callused; punctures coarse, confluent, rugose; pubescence fine, appressed, dense; prosternum deeply impressed, coarsely, deeply punctate except for apical one-third, intercoxal process abruptly declivous, coxal cavities open behind; meso- and metasternum very minutely, densely punctate, very finely, densely pubescent; scent glands obvious. Elytra about three times as long as broad; eburneous fasciae white, with a few hairs, basal pair contiguous, outer slightly longer than inner, median pair contiguous, elongate, more than twice as long as respective basal fasciae, integument black at posterior end of basal fasciae and at apex and base of median pairs; basal punctures moderately coarse, shallow, dense, becoming obsolete toward apex; pubescence very short, dense, longer, erect hairs sparsely interspersed, more numerous at apex; apices emarginate-truncate, outer angles with a prominent curved spine, inner angles dentate. Legs slender; hind femora surpassing elytral apices; middle and hind femora with a long spine internally, unarmed externally. Abdomen very finely, densely punctate, densely pubescent; last sternite rounded at apex, shallowly emarginate at middle. Length, 12–15 mm.

FEMALE: Form similar. Antennae a little longer than body. Abdomen with last sternite subtruncate at apex. Length, 13–18 mm.

HOLOTYPE MALE, allotype (California Academy of Sciences) and 15 paratypes (5 males, 10 females) from 5 MILES N. MAZATLAN, SINALOA, MEXICO, at black and white lights, 27, 28 July 1964 (J. A. Chemsak, J. A. Powell), 5–7, 24–29 July 1964 (H. F. Howden), 21 July 1972 (J. A. and M. A. Chemsak, A. E. and M. Michelbacher), 25, 29 July 1973 (Chemsak, E. G. & J. M. Linsley, A. & M. Michelbacher), 26, 28 July, 1 August 1973 (E. Giesbert).

In his characterization of *E. aegrota*, Bates stated that his specimen was a female from Plan del Rio. The only specimen from this unknown locality in the collections of the British Museum (Natural History) is a male which we determine as being the type. A female from Jalapa may be conspecific but another male from Acapulco designated as *aegrota* represents another species. Based on the male type of *aegrota*, *E. paraegrota* differs by the long, curved outer spine of the elytra, longer elytra, longer femoral spines, and by the presence of numerous erect hairs on the elytra.

Although the type series is uniform in coloration, there is some variation in the amount of black between the eburneous elytral fasciae. The lateral pronotal tubercles vary in size but are always present. Also, the inner apical angles of the elytra vary from a short tooth to a small spine. One specimen has the inner pair of basal fasciae greatly reduced and another appears to lack the long spine on the hind femur. However, the spine has been broken off and the other leg is absent.

***Eburia poricollis*, new species**

(Fig. 11)

MALE: Form large, robust, subparallel; integument dark reddish black, antennae usually paler; eburneous fasciae yellowish, small, separated; pubescence beige to golden, very short and fine on elytra. Head rather small, median line very deep, bordered by raised carinae which terminate at a deep pit on vertex; palpi subequal, apical segments prominent but not dilated; genae acute at apices; antennal tubercles prominently produced, apices blunt; pubescence dense, appressed; antennae slender, extending more than three segments beyond apex of elytra; scape robust, broadly impressed for its length, coarsely, rugosely punctate, sparsely pubescent, segments from third moderately densely clothed with short recumbent pubescence, third segment densely fringed with long erect hairs beneath, fringe becoming much sparser to sixth segment, third segment longer than first, fourth equal to third, fifth slightly longer than third, eleventh longest, slender. Pronotum broader than long, each side with a large, acute, upwardly recurved spine, lateral callus behind apex prominent; disk with two blunt tubercles before middle and a median flat glabrous callus toward base; sides near base vaguely callused; surface with very large pock-like punctures around calluses, punctures absent at base across disk; pubescence around calluses and punctures dense, appressed; prosternum impressed, coarsely, irregularly punctate, intercoxal process abruptly declivous, coxal cavities open behind; meso- and metasternum finely, irregularly punctate, densely clothed with yellowish appressed pubescence, scent glands obvious. Elytra about two and one-half times as long as broad; eburneous fasciae indistinctly pubescent; punctures small, very sparse; pubescence very short, golden, appressed, not obscuring surface; apices truncate, inner angles with short spines, outer angles dentate at most. Legs slender; hind femora extending almost to elytral apices; middle and hind femora broadly bidentate at apices. Abdomen finely densely punctate, moderately densely pubescent; last sternite shallowly notched at apex. Length, 23–31 mm.

FEMALE: Form similar. Antennae extending about one segment beyond elytra. Abdomen with last sternite rounded at apex. Length, 29–30 mm.

HOLOTYPE MALE, allotype (California Academy of Sciences) and 7 paratypes (4 males, 3 females) from VALERIO TRUJANO, OAXACA, MEXICO, 4500 ft., 28, 29 July 1937 (M. A. Embury). Additional paratypes as follows: 1 male, 11 miles W. Hidalgo, Michoacan, Mexico, 12 July 1963 (F. D. Parker, L. A. Stange); 1 male, 3 miles N. Petalcingo, Puebla, Mexico, 21 August 1963 (Parker and Stange); 1 male, Jalastoc, Morelos, Mexico, 23 June 1951 (F. Mendoza P.). An additional male, not paratypical, has been seen from Acapulco, Guerrero, Mexico, 21 June 1935 (M. A. Embury).

This species is apparently related to *E. stigmatica* Chevrollet but may be separated by the dark integument, the very long, recurved lateral spines of the pronotum, the much sparser pubescence of the elytra, and the lack of apical spines at the outer elytral margin. The eburneous fasciae are present in all specimens in the type series but there appears to be a tendency toward reduction of the median pair.

Eburia submutata, new species

(Fig. 12)

MALE: Form rather large, slightly tapering; integument pale reddish brown, legs and usually antennae orange, mouthparts, pronotal spines and calluses, apices of antennal segments narrowly, fasciae of elytra very narrowly, apices of femora, and coxae in part black or infuscated; eburneous fasciae yellowish, contiguous, basal pair subequal in length, about twice as long as broad, outer median pair longer than inner, inner pair slightly longer than basal pairs; pubescence very fine, grayish, appressed, elytra lacking erect hairs. Head small, median line deep, extending onto vertex; palpi subequal, apical segments not dilated; genae acute at apices; antennal tubercles small, blunt at apices; pubescence yellowish, dense, appressed; antennae slender, extending about four segments beyond apices of elytra, scape cylindrical, not impressed, finely, densely punctate, rather sparsely pubescent; segments moderately fringed beneath, hairs becoming sparser toward apex, third segment longer than scape, fourth equal to third, fifth longer than third, eleventh longest, slender. Pronotum about as long as broad, lateral spines prominent, blunt, calluses at sides behind apex prominent; disk with two rather small tubercles; middle transversely rugose; pubescence dense, appressed, obscuring surface except for spines and calluses; prosternum deeply impressed, deeply, separately punctate over basal one-half, pubescence dense, intercoxal process abruptly declivous, coxal cavities open behind; meso- and metasternum minutely punctate, very densely pubescent, scent glands obvious. Elytra about two and one-half times as long as broad; eburneous fasciae with a few inconspicuous hairs; basal punctures coarse, dense, becoming much finer and shallow toward apex; pubescence very fine, obscuring surface, a few longer hairs present at apices; apices truncate, bispinose, outer spine as long as hind femoral spine, inner spines short. Legs slender; hind femora reaching to elytral apices; middle and hind femora with prominent spines internally at apices, middle pair dentate externally, hind pair with external spine as long as inner elytral spines. Abdomen very densely pubescent, first four sternites with a narrow glabrous band at posterior margins; last sternite truncate at apex. Length, 20–33 mm.

FEMALE: Form similar. Antennae extending about two segments beyond apices of elytra. Abdomen with last sternite broadly rounded at apex. Length, 24–33 mm.

HOLOTYPE MALE, allotype (California Academy of Sciences) and 7 paratypes (4 males, 3 females) from SAN JERONIMO, VOLCAN TACANA, CHIAPAS, MEXICO, 13 August 1970, 12 & 18 September 1970, 6–15 October 1970, 3–25 November 1970 (E. C. Welling); additional paratypes: 3 males, 4 females, Hogar Infantil, Ocozocoautla, Chiapas, Mexico, 10 August, 14 September, 7 October 1972 (M. P. Levin).

Variation in the type series is primarily reflected in size differences. However, the outer spine of the middle femora is sometimes as long as that of the hind femora and a few of the specimens have vague costae connecting the two sets of eburneous fasciae.

This species resembles *E. mutata* Bates but may be separated by the absence of a median dorsal callus on the pronotum, the more prominent lateral spines of the pronotum, the smaller eburneous fasciae, and by

the dark annulations of the antennae and femoral apices. *E. submutata* is distinguished from *E. pedestris* White by the paler integument, the non-impressed antennal scape, and the shorter femoral spines.

LITERATURE CITED

- BATES, H. W. 1879-1885. Longicornia. In, *Biologia Centrali-Americana, Insecta, Coleoptera*, 5: 1-436, pls. 1-24.
- CHEMSAK, J. A. AND E. G. LINSLEY. 1970a. New Mexican species of *Eburia* Serville and *Eburodacrys* Thomson (Coleoptera: Cerambycidae). *Pan-Pacific Entomologist*, 46: 299-305.
- 1970b. Death-feigning among North American Cerambycidae (Coleoptera). *Pan-Pacific Entomologist*, 46: 305-307, 1 fig.
- LINSLEY, E. GORTON. 1962. The Cerambycidae of North America. Part III. Taxonomy and classification of the subfamily Cerambycinae, tribes Opsimini through Megaderini. *Univ. California Publ. Ent.*, 20: 1-188, 56 figs.

SCIENTIFIC NOTE

Collection records of the Black Witch Moth, *Ascalapha odorata* (Linnaeus) in Nevada (Lepidoptera: Noctuidae).—The black witch moth, *Ascalapha odorata* (Linnaeus) (Oiticica Filho, 1962. *Arq. Mus. Nac. Rio de Janeiro* 52: 137-144), which in the past was most commonly known as *Erebus odora* (L.), is predominantly a tropical species commonly found in the southern United States and occasionally straying into the northern states. The moth has been reported as far north as Canada, from Colorado (Smith, 1893. *U. S. Nat. Mus. Bull.* 44: 366-367; Holland, 1903. *The Moth Book*, p. 279; Comstock and Comstock, 1909. *A Manual of the Study of Insects*, p. 297), Kansas (Howe, 1963. *Our Butterflies and Moths*, p. 94) and there are many records from California. In Hawaii, *A. odorata* was first observed in 1928 (Swezey and Bryan, 1929. *Hawaiian Entomol. Soc., Proc.* 7: 236-237) where it has since increased in abundance and importance (Bryan, 1972, personal communication). The occurrence of *A. odorata* in Nevada has not previously been reported.

The following are the known collection records for *A. odorata* in Nevada:

Washoe Co., Verdi, 1464 m elevation, 16 August 1959, at night light, wings in ragged condition (Ira La Rivers) Biological Society of Nevada; Churchill Co., base of Stillwater Range, near Dixie Valley (town), 1067 m elevation, 17 July 1964 (Thomas S. Briggs) University of California, Berkeley; Esmeralda Co., Dyer, 1488 m elevation, 10 July 1968 (Maxine E. Sprouse) Nevada State Department of Agriculture, Reno. (The specimen was originally sent to Robert Lauderdale, University of Nevada Extension Service, then forwarded to Robert Bechtel, Nevada State Department of Agriculture. No collection data was included in the letter from M. Sprouse other than the return address and date); Washoe Co., Reno, 1372 m elevation, 18 July 1972, flying, 1100 hours, daylight saving time, 32°C, wings undamaged.—THOMAS LUGASKI and WILLIAM H. CLARK, *Department of Biology, University of Nevada, Reno, Nevada 89507.*

New species of *Eurytoma* associated with Cynipidae¹

(Hymenoptera: Eurytomidae)

E. E. GRISSELL

*Division of Plant Industry,**Florida Department of Agriculture and Consumer Services, Gainesville, Fla. 32601*

The genus *Eurytoma* Illiger was last revised in 1967 by Dr. R. E. Bugbee. Since that time a number of additional species have been described prompting him to update his revision. I am publishing the following names to make them available for inclusion in his forthcoming work as well as for use in my own study of *Eurytoma* associated with Cynipidae. In addition, the types of *E. californica* Ashmead and *E. querci* Fullaway have been compared and are considered conspecific. The latter name has been placed in synonymy with *E. californica*.

***Eurytoma adiacrita* Grissell, new species**

HOLOTYPE FEMALE.—Length 4.2 mm. Mostly black with yellow as follows: fore and midfemora mostly, hindfemur apically, foretibia below entirely and along margins above, mid and hindtibiae apically, hindtarsus distally. Mandibles and wing veins reddish brown. Pubescence silvery white. Flagellum filiform with F1-4 longer than wide, F5 about as wide as long, pedicel 0.78 times length of F1. Face not striate, malar space with setigerous pits, post genal lamella present. Depression on anterior face of forecoxa distinct, moderately deep. Propodeum with wide median furrow, narrowing ventrally, lateral carinae complete to base, central carina distinct in upper $\frac{3}{4}$ of furrow, lateral surfaces wide with irregular ridges, spaces between ridges with small, uneven punctures. Postmarginal vein straight, 1.0 times length of marginal vein (Fig. 7). Abdomen oval in lateral view and somewhat compressed (Fig. 5), petiole directed downwards and with a distinct projection dorsally, ovipositor tilted about 35° from horizontal axis of abdomen, lateral surfaces of tergum VI with dense reticulation covering lower $\frac{1}{3}$ completely, thinning to anterior margin medially, very sparse reticulation extending dorsally as a thin band along anterior margin, terga IV and V laterally with heavy reticulation covering anterior half of surface, thinning dorsally as on VI, dorsal surfaces of segments IV-VI appearing highly polished with reticulations showing only under certain reflections, tergum VI in dorsal view 1.8 times as long as V and in lateral view $\frac{1}{3}$ length of abdomen, tergum IX 0.28 mm. Genitalia as in Figure 2.

ALLOTYPE MALE.—Length 2.3 mm. Color as in female except mid and hindfemora and tibiae mostly black. Antenna with five pedicellate flagellomeres which are longer than wide and a terminal unit of two closely fused articles, scape swollen anteromedially (Fig. 13). Face and coxae as in female. Propodeum about as in female except central carina distinct in upper half of furrow. Post-

¹ Contribution No. 273, Bureau of Entomology, D.P.I., F.D.A.C.S.

marginal vein 1.0 times length of marginal vein. Abdominal petiole cylindrical, 3.1 times as long as widest point, 1.3 times length of hindcoxa.

HOLOTYPE FEMALE, FOLSOM LAKE, PLACER COUNTY, CALIFORNIA, emerged May 1967 from *Besbicus conspicuus* (Kinsey) on *Quercus lobata* Nee, D. C. Dailey collector; allotype male, 12 ♀, and 8 ♂ paratypes same data as holotype except em. 2–11 May 1967. Paratypes, 14 ♀, 12 ♂ all from California: Contra Costa Co.: 4 ♀, 5 ♂, Mt. Diablo State Park, 4 November 1958 (R. L. Doutt) ex *Antron echinus* (Ashmead) on *Q. douglasii* Hooker and Arnott. Placer Co.: 8 ♀, 3 ♂, Rocklin, em. 12 May to 14 June 1967 (D. C. Dailey) ex *Antron echinus* on *Q. douglasii*. Yolo Co.: 2 ♀, 4 ♂, 3 miles sw. Madison, em. 29 October to 15 November 1968 (E. E. Grissell) from *Andricus kingi* Bassett on *Q. lobata*.

Holotype, allotype, and paratypes of *E. adiacrita* are deposited in the Entomology Museum, University of California at Davis. Paratypes have also been placed in the Division of Biological Control (University of California, Albany), in the U.S. National Museum, and in the Bugbee Collection (Meadville, Pa.).

Variation.—Females of *E. adiacrita* range in length from 2.7 to 5.3 mm ($\bar{x} = 3.8$; $N = 36$) and males from 1.6 to 3.1 mm ($\bar{x} = 2.3$; $N = 29$). In females the pedicel averages 0.67 times F1 (range 0.47–0.90), the postmarginal vein averages 0.98 times the marginal vein (0.86–1.2), tergum VI averages 1.9 times V (1.5–2.3), and tergum IX averages 0.20 mm (0.11–0.30). In males the postmarginal vein averages 0.98 times the marginal (0.86–1.2); the abdominal petiole averages 3.0 times as long as wide (2.4–3.8) and 1.3 times the length of the hindcoxa (1.1–1.4).

E. adiacrita is predominantly black. The legs, however, may show some variation in the amount of yellow coloration. Some large specimens of both sexes have two shallow, submedian depressions just above the clypeus. In smaller specimens, these depressions are not distinct. Males, in many instances, have the scape distinctly enlarged anteromedially (Fig. 13), but this is not always as pronounced as illustrated. In both sexes the median furrow of the propodeum is complete, but in some specimens the lateral carinae become irregular ventrally. While the central carina is so indistinct ventrally as to appear incomplete, it is generally present at least in the upper half of the furrow of both sexes.

Hosts.—*Eurytoma adiacrita* has been reared from galls of the cynipids *Antron douglasii* (Ashmead), *Andricus kingi* Bassett, and *Besbicus conspicuus* on *Quercus lobata*, and *Antron echinus* on *Q. douglasii*. *Antron douglasii* and *A. echinus* also serve as hosts for *Eurytoma foligalla* Bugbee, and both species of *Eurytoma* may occasionally be reared from the same species of cynipid (though not necessarily the same gall) occurring in the same locality.

Systematics.—*E. adiacrita* may run to one or other of two species

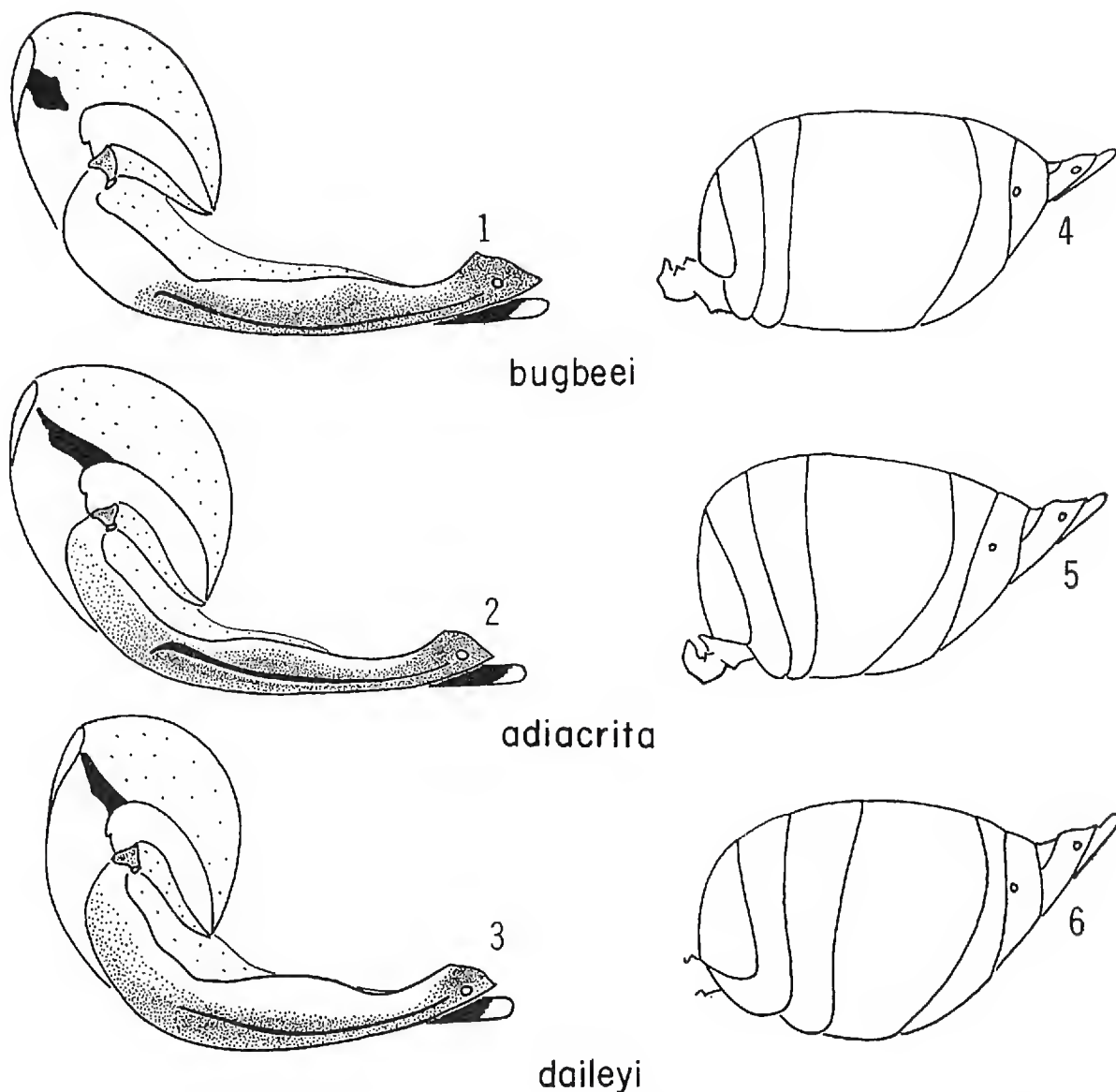
in Bugbee's revision of the genus *Eurytoma* (1967). Couplet 30 of his key (Complex IV. *Tylodermais*) is based upon the average length and range of the ninth abdominal tergum. *E. adiacrita* overlaps either choice of the couplet depending on whether the average length or range of the ninth tergum is used. If smaller specimens of *E. adiacrita* (i.e. those with shorter ninth terga) are keyed, they run to *E. spongiosa* Bugbee. *E. adiacrita* may be separated from *E. spongiosa* by its longer sixth tergum and more dorsally produced stylet arch in the female and its longer postmarginal vein in both sexes. Larger specimens of *E. adiacrita* key to couplet 42. Here, *E. adiacrita* may be distinguished from *E. spina* Bugbee by its dorsally produced stylet arch and its narrow dorsal valves; it differs from the remaining species by its complete median furrow.

Among Californian species of *Eurytoma* attacking cynipids on oak, *E. adiacrita* is most easily confused with *E. foligalla* because they are often reared from the same hosts. Females of *E. adiacrita* may be distinguished by the compressed abdomen, tergum VI almost twice the length of V, the lack of heavy reticulation dorsally on tergum VI, and the darker coloration of the scape and legs.

Males of *E. adiacrita* are not morphologically separable from those of *E. foligalla*. On the basis of color, *E. adiacrita* may generally be separated by its black trochanters. *E. foligalla* usually has yellow trochanters. This character, while useful, is not consistent in all cases. It is best, where possible, to make associative rearings of both sexes.

***Eurytoma bugbeei* Grissell, new species**

HOLOTYPE FEMALE.—Length 2.4 mm. Mostly black and yellow, some reddish brown. Yellow as follows: undersides of scape, pedicel and flagellum, mid and hindtrochanters, distal third of fore and midfemora, distal tip of hindfemur, all tibiae and tarsi. Reddish brown as follows: flagellum above, two small spots at base of antennal sockets, mandibles, wing veins. Pubescence silvery white. Flagellum filiform with F1-3 longer than wide, F4-5 about as wide as long, pedicel 0.80 times length of F1. Striae converging on clypeus from middle of face, malar space bare, lacking setigerous pits, a thin deep groove present ventrad of compound eye fading towards mandible (Fig. 10), post genal lamella absent. Depression on anterior face of forecoxa indistinct, shallow. Propodeum shallowly depressed, without a median furrow, median and lateral carinae absent, area covered with evenly spaced, fine punctures. Postmarginal vein 0.50 times length of marginal vein which is twice as wide as postmarginal (Fig. 9). Abdomen oval in lateral view (Fig. 4), ovipositor tilted at about a 35° angle in relation to horizontal axis of abdomen, lateral surface of tergum VI with heavy reticulations covering lower half almost completely, narrow band continuing to $\frac{3}{4}$ tergum height anteriorly, reticulation on terga IV and V similar to VI but correspondingly narrower, dorsal and dorsolateral areas of terga IV-VI polished, tergum VI



FIGS. 1-6. Female *Eurytoma*, lateral view. Figs. 1-3. Genitalia. Figs. 4-6. Abdomens.

in dorsal view 3.1 times as long as V, and in lateral view about $\frac{1}{2}$ length of abdomen, tergum IX 0.15 mm. Genitalia as in Figure 1.

ALLOTYPE MALE.—Length 1.9 mm. Color as in female except as follows: scape, pedicel, and flagellum entirely black, trochanters all black, fore and midfemora yellow apically, hindfemur entirely black, hind tibia mostly black. Antenna with four pedicellate flagellomeres which are longer than wide, F5 separated from the two-articled terminal unit by a distinct annulation, scape not swollen anteromedially (Fig. 11). Face, coxae, and propodeum as in female. Postmarginal vein 0.50 times length of marginal vein. Abdominal pectiole cylindrical, narrowing slightly distally, 2.4 times as long as broad, 1.1 times length of hindcoxa.

HOLOTYPE FEMALE, 1.5 MILES NORTHEAST THORNTON, SAN JOAQUIN COUNTY, CALIFORNIA, emerged 10 May 1968 from *Disholcaspis eldoradensis* (Beutenmueller) on *Quercus lobata*, S. Rosenthal and E. E. Grissell collectors; allotype male, 2 ♀, 3 ♂, same data as holotype. Paratypes, 7 ♀, 5 ♂, all from California: Napa Co.: 1 ♀, 7 miles w. Monticello Dam, em. 1 February 1968 (E. E. Grissell) from *Disholcaspis corallina* (Bassett) on *Quercus douglasii*; 2 ♀, Monticello, 11 Sep-

tember 1958 (R. L. Doutt) from terminal bud gall on *Quercus durata* Jepson. Marin Co.: 1 ♀, 1 ♂, Carson Ridge, em. 23 January 1968 (E. E. Grissell) from *Disholcaspis plumbella* Kinsey on *Q. durata*. Sacramento Co.: 2 ♀, Hood, em. 26 December 1964 and 26 March 1965 (S. Rosenthal) ex *Andricus kingi* on *Q. lobata*. Yolo Co.: 2 ♂, 2 miles e. Monticello Dam, em. 29 January 1968 (E. E. Grissell) ex *Disholcaspis eldoradensis* on *Q. lobata*; 1 ♀, 2 ♂, 3 miles sw. Madison, em. 31 October 1968 (E. E. Grissell) ex *Andricus kingi* on *Q. lobata*.

Holotype, allotype, and paratypes are deposited in the Entomology Museum, University of California at Davis. Paratypes have also been placed in the Division of Biological Control (University of California, Albany), the U. S. National Museum, and the Bugbee Collection (Meadville, Pa.).

Variation.—Females of *E. bugbeeii* range in length from 1.8 to 2.9 mm ($\bar{x} = 2.4$; $N = 9$) and males from 1.3 to 2.2 mm ($\bar{x} = 1.9$; $N = 10$). In females the pedicel averages 0.83 times F1 (range: 0.70–1.0), the postmarginal vein averages 0.56 times the marginal (0.50–0.67), tergum VI averages 3.5 times V (3.0–4.3), and tergum IX averages 0.13 mm (0.09–0.16). In males the postmarginal vein averages 0.54 times the marginal (0.46–0.67); the abdominal petiole averages 2.8 times as long as wide (2.4–3.3) and 1.1 times the length of the hindcoxa (1.0–1.2).

E. bugbeeii does not appear to vary significantly in structural characters (e.g. striae on face, smooth malar space, finely punctate propodeum) but may vary slightly in color. In females the red subantennal spots are present in most cases, but are absent in all but one male (the allotype). About half the female paratypes show some brownish coloration of the tegulae correlated with a slight increase in yellowing on the fore and midfemora. All female paratypes have the mid and hind trochanters yellow. Male paratypes have both the tegulae and trochanters black.

Hosts.—All but three specimens of *E. bugbeeii* were reared from galls caused by members of the genus *Disholcaspis*. Several species of *Eurytoma* from California (*californica*, *foligalla*, *furva* Bugbee) have been recorded from the same species of *Disholcaspis* galls, and it is apparent that much biological work needs to be done in order to better understand the exact relationships of these *Eurytoma* to their host(s). The species of *Disholcaspis* galls from which *E. bugbeeii* was reared are thick-walled, monothalamous galls. It is within the single, central chamber that the large *Disholcaspis* larva develops. However, the pithy walls of the gall may also harbor several larvae of other, smaller species of Cynipidae. These are inquilines in the genus *Synergus*. Based pri-

marily on size, *E. bugbeeii* is probably parasitic on one or more species of *Synergus* rather than on the gall-former itself.

Three specimens of *E. bugbeeii* were reared from the monothalamous, thin-walled gall of *Andricus kingi*. This gall also harbors members of the genus *Synergus*, but the relationships between gall-former, inquiline, and parasite are not known.

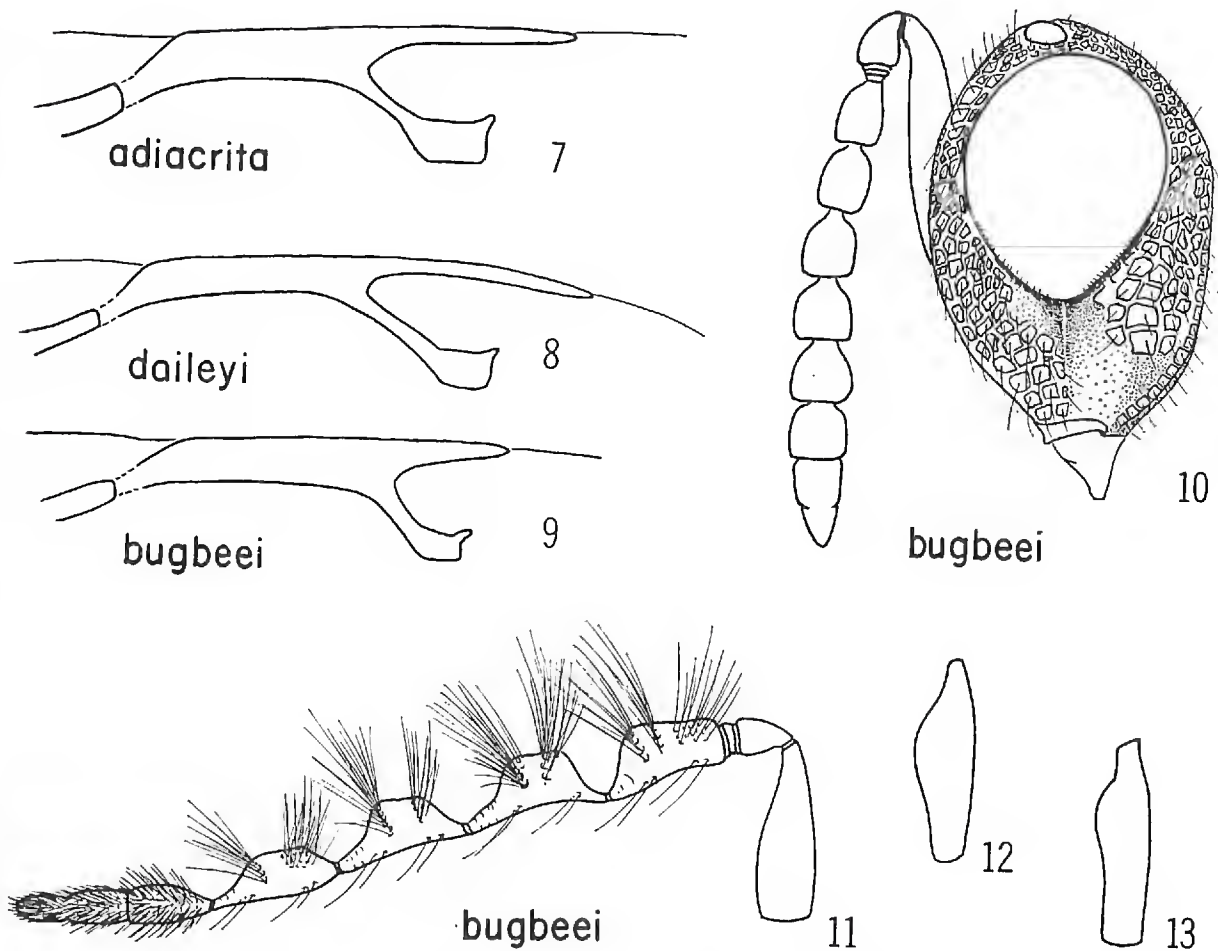
Systematics.—Females of *Eurytoma bugbeeii* key to *E. lacunae* Bugbee in Bugbee's 1967 revision of the genus *Eurytoma*. These two species are close morphologically as evidenced by the striae on the face, the shallow depression of the forecoxae, the distinctive propodeum, the lengths of the marginal and postmarginal veins, and especially the male antenna with 4 pedicellate flagellomeres. Females of *E. bugbeeii* may be separated by the absence of extensive sculpturing dorsally on tergum VI and the shorter tergum IX even though this species ranges generally slightly larger than *E. lacunae*. In addition, both sexes of *E. bugbeeii* may be separated from *E. lacunae* by a combination of the following characters: black coxae, legs mostly black, tegulae dark brown to black, and wing veins reddish brown with the marginal vein twice the width of the postmarginal (Fig. 9).

Eurytoma salicigalla Bugbee, described since Bugbee's 1967 revision of the genus, also runs to *E. lacunae* but may be separated from *E. bugbeeii* as follows: *E. bugbeeii* has the median area of the propodeum with minute, evenly spaced punctures (*E. salicigalla* with irregular carinae), tergum VI 3 to 4 times as long as tergum V (2 to 3 times in *E. salicigalla*), the lower half of tergum VI completely reticulate (lower $\frac{1}{3}$ or less in *E. salicigalla*, and then weakly so), and male with 4 pedicellate flagellomeres (5 in *E. salicigalla*).

This species is named in honor of Dr. Robert E. Bugbee whose many years of work constitute our major knowledge of Nearctic *Eurytoma*.

***Eurytoma daileyi* Grissell, new species**

HOLOTYPE FEMALE.—Length 2.5 mm. Mostly black and yellow, some reddish brown. Yellow as follows: scape, flagellum beneath, coxae and legs entirely, distal tip of ventral valves. Reddish brown as follows: mandibles, wing veins, lateral areas of abdominal terga III–VI partly. Pubescence silvery white. Flagellum moniliform with F1–3 longer than wide, F4–5 about as wide as long, pedicel 0.86 times length of F1. Face not striate, malar space with setigerous pits, post genal lamella present. Depression on anterior face of forecoxa distinct, moderately deep. Propodeum with wide but incomplete median furrow which narrows ventrally, lateral carinae distinct in upper $\frac{1}{3}$, median carina distinct in upper $\frac{1}{3}$, lateral surfaces wide and unevenly punctate. Postmarginal vein slightly curved, 0.87 times length of marginal vein (Fig. 8). Abdomen oval in lateral view (Fig. 6), ovipositor tilted at about 45° from horizontal axis of abdomen, lateral surface



FIGS. 7-13. *Eurytoma*. FIGS. 7-9. Wing veins, dorsal view. FIG. 10. Head, lateral view. FIG. 11. Male antenna, lateral view. FIG. 12. Scape of *daileyi* male, lateral view. FIG. 13. Scape of *adiacrita* male, lateral view.

of tergum VI with faint reticulation covering lower $\frac{1}{4}$, thinning to lower $\frac{1}{2}$ anteriorly, terga IV and V laterally with a small area of reticulation anteromedially, dorsal surfaces of terga IV-VI highly polished, tergum VI in dorsal view 1.7 times as long as V and in lateral view about $\frac{2}{5}$ length of abdomen, tergum IX 0.13 mm. Genitalia as in Figure 3.

ALLOTYPE MALE.—Length 1.9 mm. Color as in female except as follows: scape yellow on basal $\frac{1}{3}$, flagellum entirely black, hindcoxa smoky, hindfemur and tibia with a black smudge medially, abdomen entirely black. Antenna with five pedicellate flagellomeres which are longer than wide and a terminal unit of two closely fused articles, scape distinctly swollen anteromedially (Fig. 12). Face and coxae as in female. Propodeum as in female except median carina inconspicuous. Postmarginal vein slightly curved, 1.0 times length of marginal. Abdominal petiole cylindrical, 2.3 times as long as broad, 0.97 times length of hindcoxa.

HOLOTYPE FEMALE, MORONGA RIDGE, CONTRA COSTA COUNTY, CALIFORNIA, emerged 10 March 1968 from galls of *Diastrophus kincaidii* Gillette on *Rubus parviflorus* Nuttall, D. C. Dailey collector, No. 1051; allotype male, 6 ♀, and 3 ♂ paratypes same data except emergence from February to March. Additional paratypes, 1 ♀, 3 ♂,

Baltic Mine (near Washington), Nevada County, California, em. December 1967, same host and collector as holotype.

Holotype, allotype, and paratypes of *E. daileyi* are deposited in the Entomology Museum, University of California at Davis. Paratypes have also been placed in the U. S. National Museum and the Bugbee Collection (Meadville, Pa.).

Variation.—Females of *daileyi* range in length from 1.9 to 2.5 mm ($\bar{x} = 2.3$; $N = 16$) and males from 1.5 to 2.5 mm ($\bar{x} = 2.1$; $N = 17$). In females the pedicel averages 0.89 times Fl (range: 0.73–0.90), the postmarginal vein averages 0.90 times the marginal (0.76–1.0), tergum VI averages 1.7 times V (1.6–1.9), and tergum IX averages 0.13 mm (0.09–0.15). In males the postmarginal vein averages 0.89 times the marginal (0.82–1.0); the abdominal petiole averages 2.3 times as long as wide (1.9–2.7) and 0.93 times the length of the hind-coxa (0.82–1.1).

All specimens show at least some yellow on the coxae and legs. Females vary only slightly in terms of color (i.e. hindcoxa occasionally with a slight black smudge). Males, however, vary noticeably in the amount of yellow present on coxae and legs. In some cases all coxae may have some black infuscation. In other specimens only the forecoxae are solid yellow while the mid and hindcoxae are entirely black. In males the legs vary from all yellow to yellow with black infuscation. Both sexes appear to vary somewhat in the structure of the propodeum. The lateral carinae are never complete and may be almost absent, indicated only by short ridges at the extreme top of the furrow. The central carina may be present but incomplete, or absent. Punctuation varies from fine and dense over the entire surface (when the lateral carinae are nearly absent) to uneven and limited to lateral areas and lower third of furrow.

Systematics.—Females of *Eurytoma daileyi* key to *E. celtigalla* Bugbee in Bugbee's 1967 revision. These two species appear quite similar in size, general coloration, relationship of wing veins, the broad dorsal valves of the genitalia, and the short abdominal petiole in the males. *E. daileyi* females, however, may be separated by the following characters: flagellomeres 4 and 5 as wide as long, pedicel three-fourths or more length of Fl, tegulae black, median furrow incomplete, tergum VI in dorsal view usually distinctly less than twice the length of tergum V, and tergum IX ranging slightly shorter in length. Males of *E. daileyi* can best be separated from *E. celtigalla* by the incomplete median furrow, the black tegulae, and the long, slightly curved postmarginal vein.

This species is named in honor of Charles Dailey who has contributed greatly to our knowledge of the parasitoids of gall-forming Cynipidae.

EURYTOMA CALIFORNICA Ashmead

Eurytoma californica Ashmead, 1887: 195.

Eurytoma querci Fullaway, 1912: 278. **New Synonymy.**

The lectotype female of *E. californica* is in the United States National Museum. The holotype female of *E. querci* is housed in the Los Angeles County Museum, having been moved there from Stanford University some years ago. I have seen both types as well as several hundred specimens of *E. californica*; the holotype of *E. querci* clearly falls within the variation of *E. californica*. Fullaway associated a male specimen from a different lot number and host with the female of *E. querci*. This specimen is quite similar to males of *E. californica* but does not have the flagellomeres pedicellate and lacks the whorls of long setae on each segment, a condition not known in other North American species of *Eurytoma*. It is possible that the single male represents an aberrant specimen of *E. californica* or an undescribed species which has been incorrectly associated with this species. The possibility also arises that it is the male of an unrecognized genus.

ACKNOWLEDGMENTS

I wish to thank R. E. Bugbee (Allegheny College, Meadville, Pa.) who has given me much-needed advice as well as the gift and loan of specimens from his collection. I am indebted also to Charles Dailey (Sierra College, Rocklin, Calif.) for his help and for the loan of his invaluable collection. Additional material has kindly been provided by K. S. Hagen (Division of Biological Control, University of California, Albany) and C. L. Hogue (Los Angeles County Museum). I also wish to thank R. M. Bohart and S. L. Clement (both University of California, Davis) for their comments and suggestions concerning this manuscript.

LITERATURE CITED

- ASHMEAD, W. H. 1887. Studies on the North American Chalcididae, with descriptions of new species, chiefly from Florida. *Trans. Amer. Ent. Soc.*, 14: 183-202.
- BUGBEE, R. E. 1967. Revision of chalcid wasps of genus *Eurytoma* in America north of Mexico. *Proc. U. S. Nat. Mus.*, 118: 433-552.
- FULLAWAY, D. T. 1912. Gall-fly parasites from California. *Jour. N. Y. Ent. Soc.*, 20: 274-281.

New Species of *Leptohyphes* Eaton

(Ephemeroptera: Tricorythidae)

RICHARD K. ALLEN

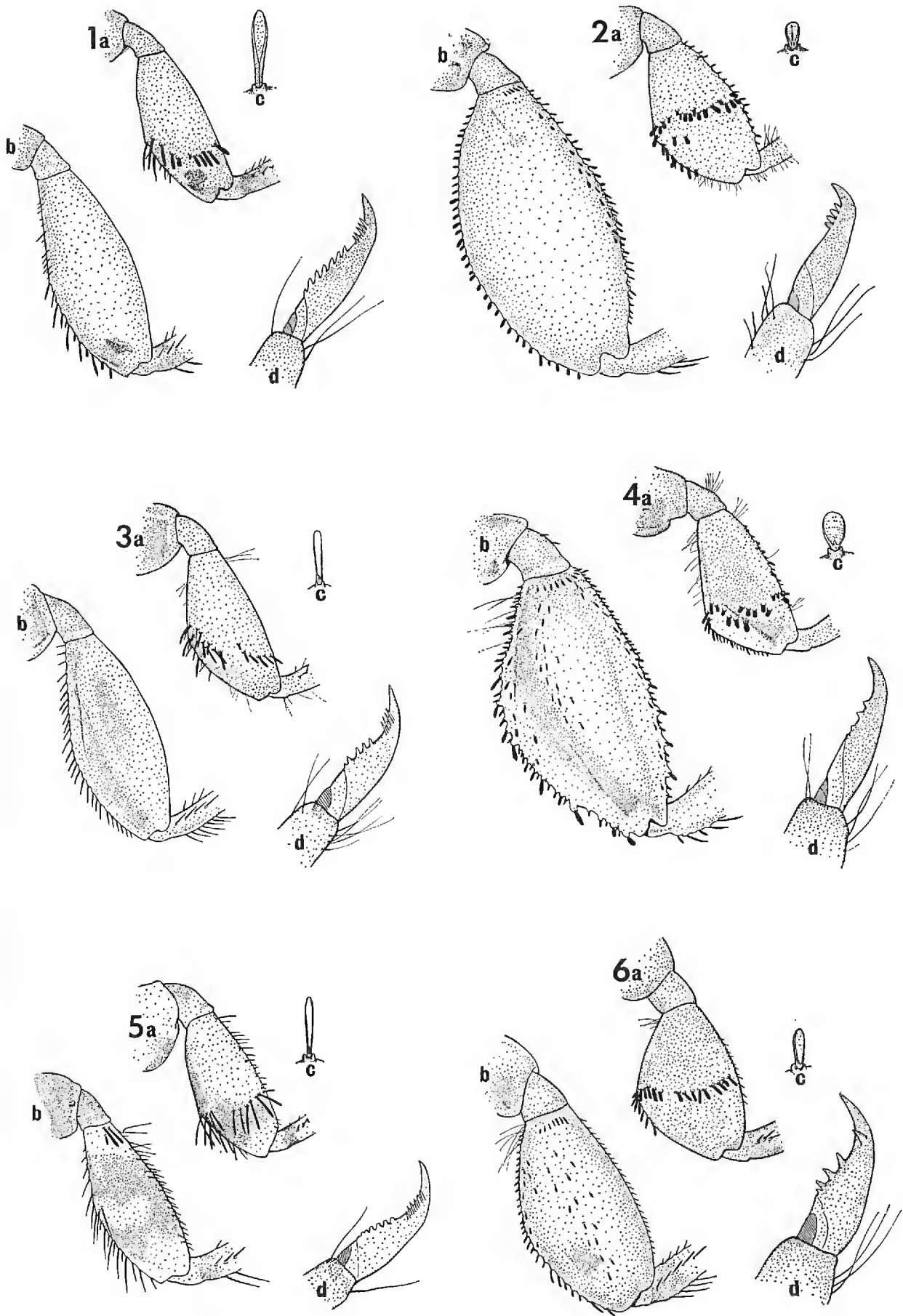
California State University, Los Angeles

Collections of *Leptohyphes* nymphs from the University of Utah, Salt Lake City, and Florida A. & M. University, Tallahassee, include ten undescribed species. Grateful acknowledgment is made to G. F. Edmunds, Jr. and W. L. Peters for loan of the material and for permission to publish names and descriptions of the species.

***Leptohyphes edmundsi* Allen, new species**

NYMPH. Length: body 4.0–5.0 mm; caudal filaments 3.0–4.0 mm. General color light brown to brown with dark brown and black markings. Head light brown with black markings; vertex light brown; head with narrow black stripe from posterior margin of compound eyes to posterior margin of head then mesad along posterior margin to near epicranial suture; transverse black band on frons between lateral ocelli; lateral ocelli small; maxillary palpi 2-segmented. Thoracic nota light brown with variable black maculae; legs light brown to pale with black markings; femora with subapical black macula (fig. 1a–b); femora with moderately long spines (fig. 1c); fore femoral band of spines as in fig. 1a; hind femora 30 percent longer than fore femora; anterior surface of middle and hind femora without spines; ventral (leading) margin of middle and hind femora without spines; dorsal margin of femora with long spines (fig. 1b); tibiae light brown with brown subbasal transverse band; tarsi light brown with brown transverse band near base; tarsal claws with 6–7 marginal denticles, and palisade of 4–5 submarginal denticles near apex (fig. 1d). Abdominal terga 1–9 brown with dark brown markings which are separated by median brown longitudinal stripe; terga 1–6 with sublateral black maculae mesad to gills (fig. 19); operculate gills brown with dark brown mark at base and pale apically; gills without apical spine (fig. 11); abdominal sterna brown to dark brown, often with dark brown lateral margins. Caudal filaments light brown.

HOLOTYPE, MATURE NYMPH, RIO CATIRAS, MORRETES, PARANA, BRAZIL, IV-65, F. Plaumann, in collection University of Utah, Salt Lake City. Paratopotypes: 20 nymphs, same data as holotype, 2 nymphs each in collections of California State University, Los Angeles; California Academy of Sciences, San Francisco; and Canadian National Collection, Ottawa; Smithsonian Institution, Washington D. C.; and Florida A. & M. University, Tallahassee, others in collection of University of Utah. Paratypes: 23 nymphs, Rio Warnow, Santa Catarina, Brazil, XI-65, F. Plaumann; 8 nymphs, Arroio Irapua, Rio Grande do Sul, Brazil, XI-65, F. Plaumann; 2 nymphs, Rio Cubatao, Santa Catarina, Brazil, XI-65, F. Plaumann; 2 nymphs, Rio das Cobras, Parana, Brazil, III-65, F. Plaumann; 8 nymphs, Rio Cavallinha, Santa Catarina, Brazil, XI-65, F. Plaumann; 21 nymphs, Arroio do Hilario, Rio Grande do Sul, Brazil, XI-65, F. Plaumann. All paratypes in collection University of Utah.



FIGS. 1-6. *Leptohyphes* nymphs, leg parts: (a) fore femur; (b) hind femur; (c) femoral spine; (d) tarsal claw. fig. 1, *L. edmundsi*; fig. 2, *L. carinus*; fig. 3, *L. flinti*; fig. 4, *L. pupulus*; fig. 5, *L. tinctus*; fig. 6, *L. invictus*.

This species is named in honor of George F. Edmunds, Jr., University of Utah, in recognition of his many contributions to our knowledge of mayfly taxonomy. *Leptohyphes edmundsi* is easily distinguished from the other described nymphs of South American *Leptohyphes* by the distinctive markings on the abdominal terga, the legs, and the abdominal gills, and by the number and arrangement of the denticles on the tarsal claws.

***Leptohyphes carinus* Allen, new species**

NYMPH. Length: body 3.5–4.5 mm; caudal filaments broken. General color brown with black markings. Head brown with narrow black stripe from posterior margin of compound eyes to posterior margin of head; lateral ocelli small; maxillary palpi 3-segmented. Thoracic nota brown with irregular black markings; legs unicolorous brown; femora with short spines (fig. 2c); fore femoral band of spines as in fig. 2a; hind femora 50 percent longer than fore femora; anterior surface of middle and hind femora with row of transverse spines at base; dorsal and ventral margins of middle and hind femora with numerous moderately long spines in elevated sockets (fig. 2b); tibiae and tarsi with long setae; tarsal claws with 4 blunt marginal denticles near apex (fig. 2d). Abdominal terga 1–3 brown with black transverse bands; terga 4–10 unicolorous brown; terga 4–9 with a round, median tubercle; operculate gills pale, black at base (fig. 12); gills with apical spine; abdominal sterna brown. Caudal filaments broken.

HOLOTYPE, MATURE NYMPH, GUYUMBA, 21 km. dc TINGO MARIA, HUALLAGA, PERU, 25-IX-63, M. Pandura, in collection University of Utah, Salt Lake City.

Leptohyphes carinus is superficially close to *L. tuberculatus* Allen as the nymphs of both bear a median row of dorsal abdominal tubercles. They are distinguished as the former lacks a tubercle at the apex of the hind femur. These species are further distinguished by the coloration of the operculate gills, the dentition on the tarsal claws, and the armature on the legs and body.

***Leptohyphes flinti* Allen, new species**

NYMPH. Length: body 3.0–4.0 mm; caudal filaments 2.5–3.5 mm. General color pale to brown and suffused with black. Head brown with black stripe on frons between lateral ocelli; lateral ocelli small; maxillary palpi 3-segmented. Thoracic nota pale to brown, suffused with black, and with complex black pattern; legs yellow; femora with moderately long spines (fig. 3c), fore femoral band of spines as in fig. 3a; hind femora 30 percent longer than fore femora; anterior surface of middle and hind femora without spines; ventral (leading) margin of middle and hind femora without spines; dorsal margin of middle and hind femora with long spines (fig. 3b); tarsal claws with 3–5 marginal denticles, and palisade of 4–5 submarginal denticles near apex (fig. 3d). Abdominal terga pale to brown and suffused with black; operculate gills brown and suffused with black, margins pale (fig. 13); gills without apical spine; abdominal sterna brown. Caudal filaments brown.

HOLOTYPE, MATURE NYMPH, SPRINGFIELD EST., DOMINICA, 26-VII-63, O. S. Flint, in collection University of Utah, Salt Lake City. Paratopotypes: 6 nymphs, same data as holotype, 2 in collection California State University, Los Angeles and 2 in collection University of Utah, and 2 in collection Smithsonian Institution.

This species is named in honor of Oliver S. Flint, Jr., Smithsonian Institution, Washington, D. C., the collector of the type material. There are two other species of *Leptohyphes* now known from the West Indies, and *L. flinti* is distinguished from these, and all others in the genus, by the following combination of characters: (1) by the coloration of the abdomen, legs, and gills; (2) by the length of the femoral spines; and (3) by the number and arrangement of the denticles on the tarsal claws.

Leptohyphes pupulus Allen, new species

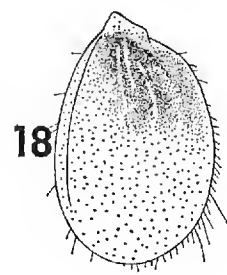
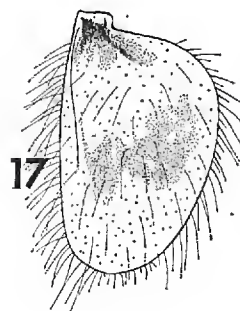
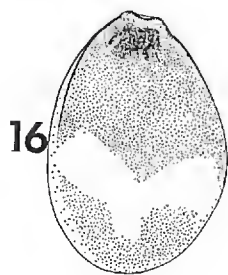
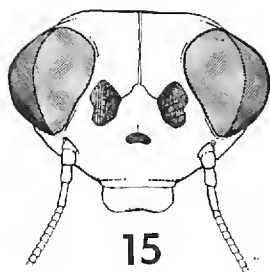
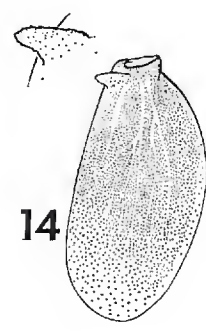
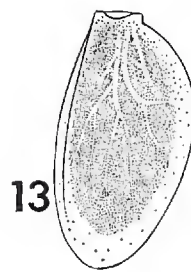
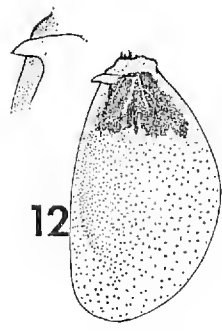
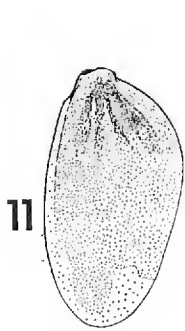
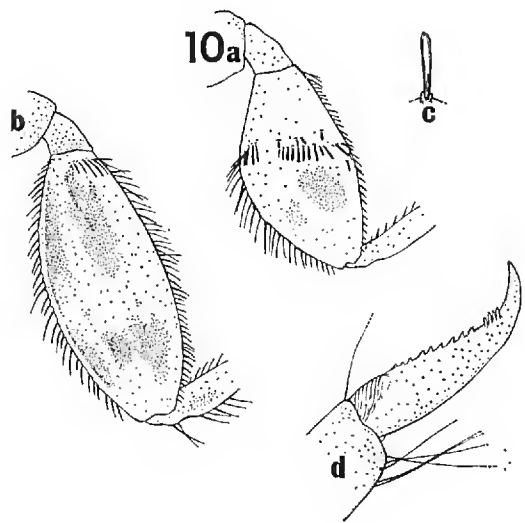
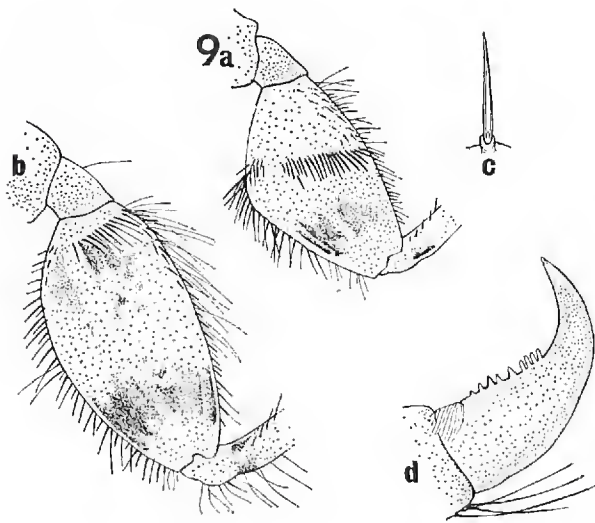
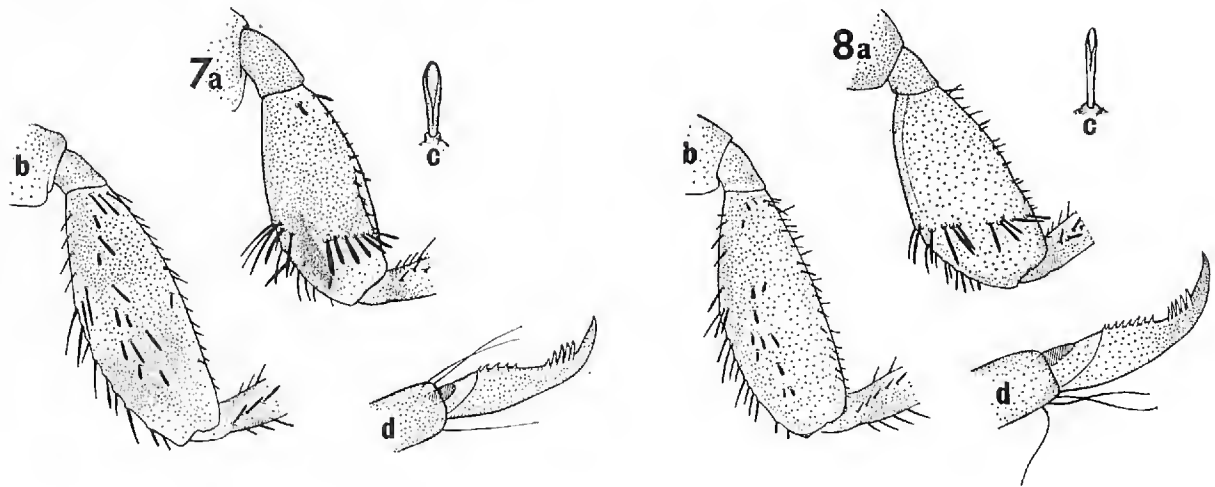
NYMPH. Length: body 4.0–5.0 mm; caudal filaments 4.0–5.0 mm. General color brown with dark brown markings. Head brown with dark brown markings on vertex and frons between lateral ocelli; compound eyes large, divided in male (fig. 15); compound eyes two-colored, outer portion black, inner portion brown; lateral ocelli large; maxillary palpi 3-segmented. Thoracic nota brown with dark brown markings; legs brown; femora with short, heavy spines (fig. 4c); fore femoral band of spines as in fig. 4a; marginal spines of hind femora in elevated sockets (fig. 4b); hind femora 45 percent longer than fore femora; anterior surface of middle and hind femora with spines; dorsal and ventral margins of middle and hind femora with spines (fig. 4b); tibiae and tarsi brown; tarsal claws with 3–4 marginal denticles (fig. 4d). Abdominal terga brown, suffused with black and with dark brown spots; abdominal terga 6–8 with dark brown transverse band on posterior margin; operculate gills light brown, suffused with black, gills with apical spine (fig. 14); abdominal sterna brown. Caudal filaments light brown.

HOLOTYPE, MATURE MALE NYMPH, RIO MARAUIA, 3 days above SAN ANTONIO MISSION, NW. TAPARUQUARA, AMAZONAS, BRAZIL, 26/27-I-63, F. J. Fittkau, in collection University of Utah, Salt Lake City.

Leptohyphes pupulus is the first species in which the male nymph is known to possess divided compound eyes. It is distinguished from all other described South American species by this character, and by the combination of the dorsal abdominal color pattern, the number,

→

FIGS. 7–10. *Leptohyphes* nymphs, leg parts: (a) fore femur; (b) hind femur; (c) femoral spine; (d) tarsal claw. fig. 7, *L. minimus*; fig. 8, *L. viriosus*; fig. 9, *L. jamaicanus*; fig. 10, *L. rolstoni*. FIGS. 11–18. body parts: fig. 11, gill, *L. edmundsi*; fig. 12, gill, *L. carinus*; fig. 13, gill, *L. flinti*; fig. 14, gill, *L. pupulus*; fig. 15, head, *L. pupulus*; fig. 16, gill, *L. viriosus*; fig. 17, gill, *L. jamaicanus*; fig. 18, gill, *L. rolstoni*.



shape, and arrangement of the denticles on the tarsal claws, and by having elevated spines on the hind femora.

***Leptohyphes tinctus* Allen, new species**

NYMPH. Length: body 3.0–4.0 mm; caudal filaments broken. General color pale with brown markings. Head pale with brown markings; head with paired brown maculae on occiput mesad of compound eyes; frons brown except pale around median ocellus and bases of antennae; lateral ocelli small; maxillary palpi 2-segmented, apical segment with terminal seta. Thoracic nota pale with small black maculae; pronotum pale; mesonotum with pale median macula between base of wing pads; legs pale with brown markings; femora pale at base and with median brown macula (fig. 5a–b); femora with long spines (fig. 5c); fore femoral band of spines as in fig. 5a; hind femora 10 per cent longer than fore femora; anterior surface of middle and hind femora with 3–5 long spines near base (fig. 5b); dorsal and ventral margins of middle and hind femora with long spines (fig. 5b); tibiae pale with subbasal and subapical transverse bands; tarsal claws with 6–8 marginal denticles and palisade of 5–7 submarginal denticles near apex (fig. 5d). Abdominal terga pale with brown and black maculae as in fig. 20; operculate gills pale with brown markings (fig. 20); gills without apical spine; abdominal sterna pale with brown lateral margins and paired sublateral black maculae. Caudal filaments pale with brown annulations.

HOLOTYPE, MATURE NYMPH, RIO IVAY, RIO GRANDE DO SUL, BRAZIL, XI-65, F. Plaumann, in collection University of Utah, Salt Lake City.

This species is most easily distinguished by the distinctive color pattern on the abdominal terga and operculate gills.

***Leptohyphes invictus* Allen, new species**

NYMPH. Length: body 2.5–3.5 mm; caudal filaments 2.0–3.0 mm. General color light brown with brown markings; head light brown with an irregular, large, dark brown macula on frons; head with fine spicules; lateral ocelli small; maxillary palpi 3-segmented. Thoracic nota light brown with irregular dark brown maculae; nota with fine spicules; legs light brown with apical brown tibial and tarsal bands; femora with moderately long spines (fig. 6c); fore femoral band of spines as in fig. 6a; hind femora 20 percent longer than fore femora; anterior surface of middle and hind femora with short spines (fig. 6b); ventral (leading) margin of middle and hind femora with short spines; dorsal margin of middle and hind femora with long spines (fig. 6b); tarsal claws with 2–3 marginal denticles and 1 submarginal denticle near apex (fig. 6d). Abdominal terga light brown; posterior margins of terga 2–9 with long spines; operculate gills light brown, dark near apex as in fig. 12; gills without apical spines; abdominal sterna pale. Caudal filaments pale.

HOLOTYPE, MATURE NYMPH, TULUMAYO, 29 KM. E. TINGO MARIA, SAN MARTIN PROVINCE, PERU, 23-VI-63, W. L. Peters, in collection University of Utah, Salt Lake City. Paratopotypes: 2 nymphs, same data as holotype, 1 each in collections California State University, Los Angeles, and University of Utah.

This species is distinguished from others described from South Amer-

ica by the arrangement and degree of development of the spines on the fore femora, and by the arrangement of the denticles on the tarsal claws.

***Leptohyphes minimus* Allen, new species**

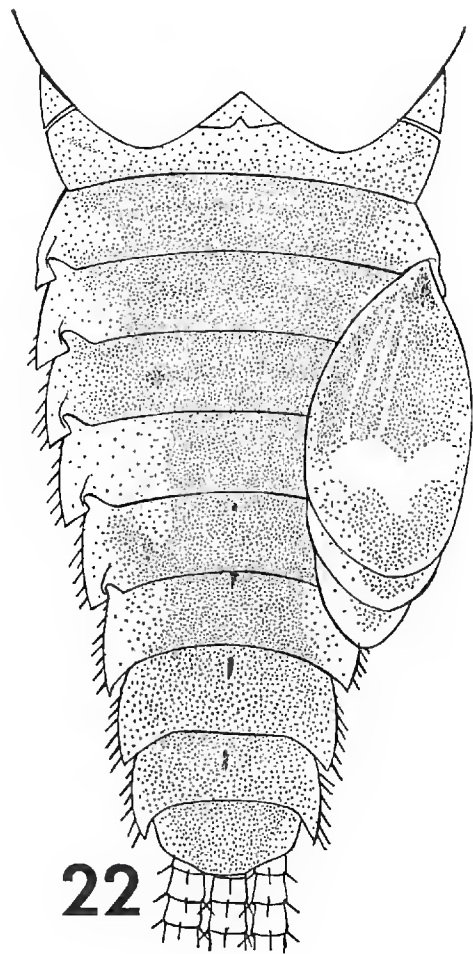
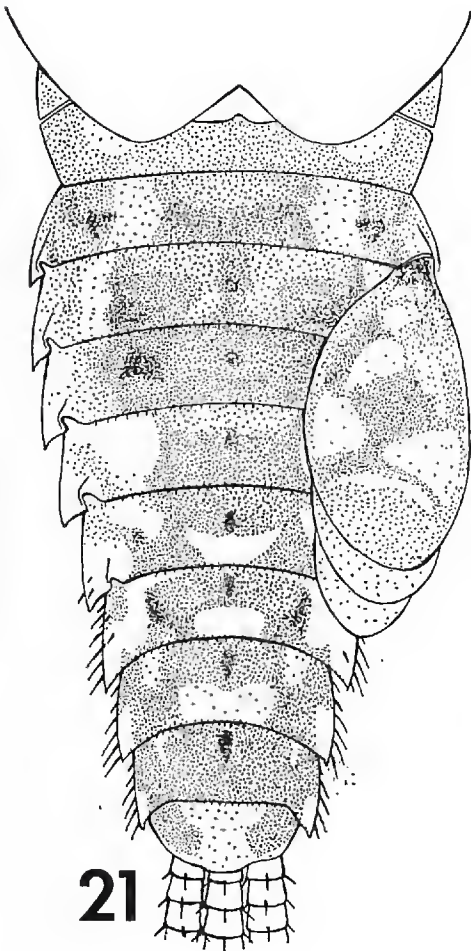
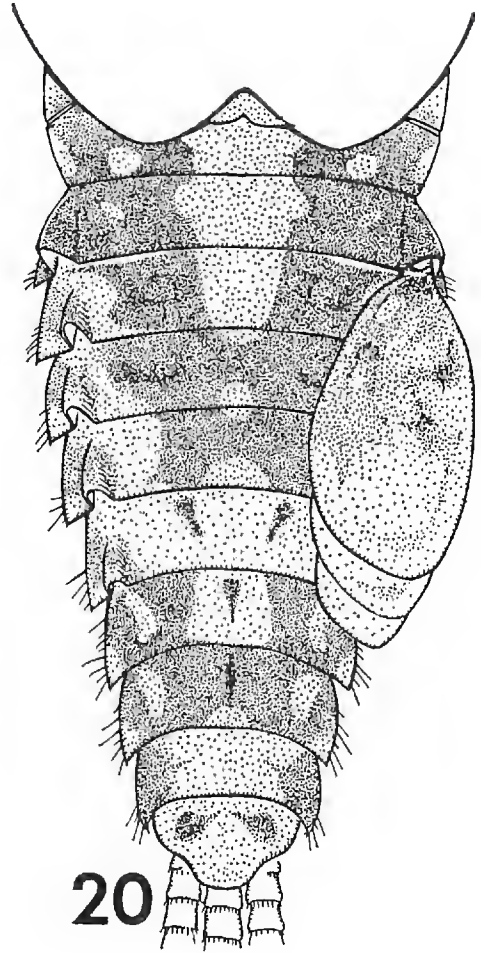
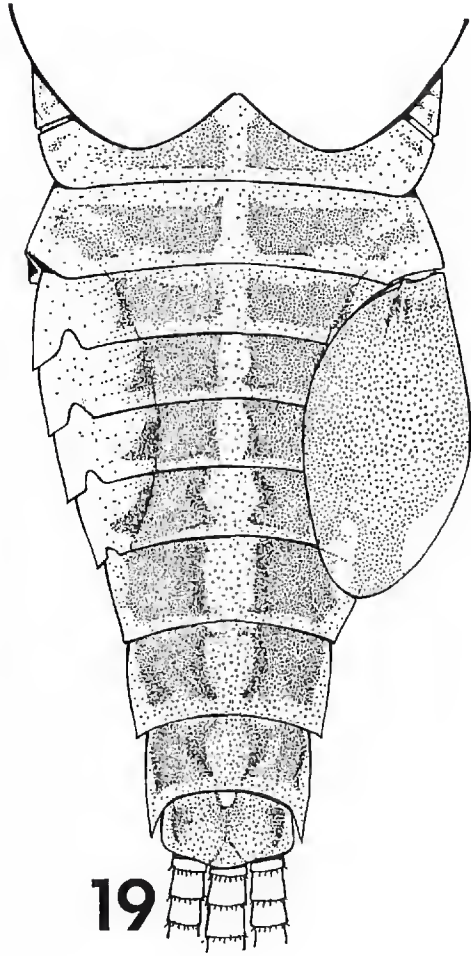
NYMPH. Length: body 2.0–3.0 mm; caudal filaments broken. General color brown with dark brown and black markings. Head brown with a pale transverse band on vertex between compound eyes; lateral ocelli small; maxillary palpi 2-segmented, apical segment with terminal seta. Thoracic nota brown with pale and black markings; pronotum brown with irregular black markings and black posterior margin; mesonotum brown with two sets of paired median pale maculae, and black lateral margins; legs brown with pale markings; femora light brown with brown subapical mark and pale apically (fig. 7a–b); femora with moderately long spines (fig. 7c); fore femoral band of spines as in fig. 7a; hind femora 10 percent longer than fore femora; anterior surface of middle and hind femora with long spines (fig. 7b); ventral (leading) margin of middle and hind femora with moderately long spines; dorsal margin of middle and hind femora with long spines; tibiae brown with subbasal and subapical brown bands; tarsi with median brown band; tarsal claws with 5–7 marginal denticles and palisade of 5–6 denticles near apex (fig. 7d). Abdominal terga brown with pale and black maculae; terga 1–8 with pale submedian and black sublateral maculae; terga 3–8 with black median macula; tergum 10 pale with paired lateral brown maculae (fig. 21); operculate gills brown with pale markings and pale transverse line near middle of lamellae (fig. 21); gills without apical spine; abdominal sterna brown. Caudal filaments brown.

HOLOTYPE, MATURE NYMPH, ARROIO LAGEADO, RIO GRANDE DO SUL, BRAZIL, XI-64, F. Plaumann, in collection University of Utah, Salt Lake City. Paratypes: 7 nymphs, same data as holotype, 3 in collection California State University, Los Angeles, and 4 in collection University of Utah.

Leptohyphes minimus is distinguished from all other nymphs of the genus by its small size, and distinctive color patterns on the abdominal terga and tracheal gills.

***Leptohyphes viriosus* Allen, new species**

NYMPH. Length: body 3.0–4.0 mm; caudal filaments broken. General color pale with brown and black markings. Head pale with brown markings; occiput with paired brown maculae mesad to compound eyes; frons brown except pale around median ocellus and bases of antennae; lateral ocelli small; maxillary palpi 2-segmented, apical segment with terminal seta. Thoracic nota pale with small black maculae; legs brown with darker brown markings; femora brown; femora with long spines (fig. 8c); fore femoral band of spines as in fig. 8a; hind femora 10 percent longer than fore femora; anterior surface of middle and hind femora with spines (fig. 8b); ventral (leading) margin of middle and hind femora with moderately long spines; dorsal margin of middle and hind femora with long spines (fig. 8b); tibiae pale with brown transverse bands; tarsal claws with 6–8 marginal denticles, and palisade of 5–6 submarginal denticles near apex (fig. 8d). Abdominal terga brown with pale maculae and black spots; terga 2–7 with pale lateral margins; terga 6–9 with median black spot (fig. 22); operculate gills



brown, dark brown at apex, and with pale heart-shaped maculae near base; gills without apical spine (fig. 16); abdominal sterna pale with brown lateral margins and paired sublateral black maculae. Caudal filaments pale with brown annulations.

HOLOTYPE, MATURE NYMPH, RIO IVAY, RIO GRANDE DO SUL, BRAZIL, XI-64, F. Plaumann, in collection University of Utah, Salt Lake City.

This species is most easily recognized by the distinctive heart-shaped macula on the operculate gills, and it may be distinguished from all other described species by the color pattern on the abdominal terga, the length, shape and arrangement of the femoral spines, and the arrangement of the dentition on the tarsal claws.

***Leptohyphes jamaicanus* Allen, new species**

NYMPH. Length: body 4.0–5.0 mm; caudal filaments 3.0–4.0 mm. General color pale with black markings. Head pale with black dots on vertex and black marking on frons between compound eyes; lateral ocelli small; maxillary palpi 3-segmented, and with long apical spine. Thoracic nota pale with complex black pattern; legs pale with black markings; fore femora pale with black subapical band (fig. 9a); middle and hind femora pale, black at base and with black subapical band (fig. 9b); femora with long sharp spines (fig. 9c); fore femoral band of spines as in fig. 9a; hind femora 30 percent longer than fore femora; anterior surface of middle and hind femora with row of spines near base (fig. 9b); dorsal and ventral margins of middle and hind femora with spines; tibiae pale with black transverse band near base; tarsi pale; tarsal claws with 7–9 marginal denticles (fig. 9d). Abdominal terga 1–10 each with median black transverse band and pale lateral margins; operculate gills nearly triangular in shape (fig. 17); gills pale with black markings; gills without apical spines; abdominal sterna pale. Caudal filaments pale.

HOLOTYPE, MATURE NYMPH, CLARENDEN, RIO MINHO, 1 MI. E. FRANKFIELD, JAMAICA, 6-III-63, T. H. FAIT & A. Barrett, in collection Florida A. & M. University, Tallahassee.

This is only one of three species of *Leptohyphes* known from the West Indies and it is distinguished from the others by the distinctive black markings on the body and legs. It is further distinguished from these, and all other species, by the shape of the operculate gills, the shape and degree of development of the femoral spines, and by the dentition on the tarsal claws.

***Leptohyphes rolstoni* Allen, new species**

NYMPH. Length: body 4.0–5.0 mm; caudal filaments 2.0–3.0 mm. General color pale to light brown with black markings. Head light brown with black

←

FIGS. 19–22. *Leptohyphes* nymphs, abdomens: fig. 19, *L. edmundsi*; fig. 20, *L. tinctus*; fig. 21, *L. minimus*; fig. 22, *L. viriosus*.

markings; vertex and occiput with penciled black markings; frons with black marking between compound eyes and lateral black markings from compound eyes anterior to clypeus; lateral ocelli small; maxillary palpi 3-segmented. Thoracic nota pale to light brown with variable black markings; legs pale with black markings; fore femora pale with black apical macula (fig. 10a); middle and hind femora pale with black markings as in fig. 10b; femora with moderately long spines (fig. 10c); fore femoral band of spines as in fig. 10a; hind femora 25 percent longer than fore femora; anterior surface of middle and hind femora with row of spines near base (fig. 10b); dorsal and ventral margins of middle and hind femora with spines (fig. 10b); tibiae and tarsi pale; tarsal claws with 7-9 small marginal denticles, and palisade of 4-5 submarginal denticles near apex (fig. 10d). Abdominal terga pale with black transverse band on each segment, band interrupted medially on segments 9-10; operculate gills pale with large black macula at base (fig. 18); gills without apical spine; abdominal sterna pale. Caudal filaments pale.

HOLOTYPE, MATURE NYMPH, SAN CRISTOBAL, DOMINICAN REPUBLIC, 5-IX-66, L. H. Rolston, in collection Florida A. & M. University, Tallahassee. Paratopotypes: 35 nymphs, same data as holotype, 5 nymphs each in collections California State University, Los Angeles and University of Utah, Salt Lake City, remainder in collection Florida A. & M.

This is the first *Leptohyphes* to be described from the Dominican Republic, and is distinguished from the other West Indian species by the color of the legs, the number of denticles and the shape of the tarsal claw, and by the shape and the markings on the operculate gills. This species is named in honor of L. H. Rolston, the collector of the type material.

BOOK NOTICE

FLIES AND DISEASE, VOLUME II. *Biology and Disease Transmission*—by Bernard Greenberg. Princeton University Press, Princeton, New Jersey, 1973. XI + 447 pp. \$18.00.

The first volume of this set consisted largely of cross-indexed lists of flies and disease organisms they transmit, with selected references. In contrast, Volume II contains extensive review and analysis of the role of flies as vectors of human (Chapter 4) and animal (Chapter 5) diseases. Together, these chapters comprise nearly 60% of the text. Chapter 1 provides a summary of prescientific attitudes and beliefs concerning flies. Chapter 2 is a review of the biology of selected species of medical importance which have not been treated in the recent literature. Included is a brief discussion of methods for estimating dispersal rates and population sizes. Chapter 3 concerns the fly as a vector, including discussions of morphological, physiological and ecological characteristics pertinent in disease transmission, as well as short discussions of laboratory rearing methods and tissue culture of flies.—Editor.

A review of the genus *Borboropsis*(Diptera: Heleomyzidae)¹

WAYNE N. MATHIS

Department of Entomology, Oregon State University, Corvallis, Oregon 97331

The genus *Borboropsis* Czerny was originally proposed in 1902 to include the single Holarctic species *B. fulviceps* (Strobl). A second species, *B. steyskali* n. sp., is described below from Oregon. Notes on the generic limits, figures, and a key are also included.

Although the genus *Borboropsis* is readily placed in the Heleomyzinae, the absence of well defined preapical tibial bristles and prominent costal spines are anomalies, atypical of most Heleomyzidae. Moreover, the absence of these structures, or their underdeveloped states, partially characterize this unique genus and led Collin (1943: 234) to consider *Borboropsis* as "the most aberrant Palaearctic genus of this family." With the addition of a second new species the generic concept must be altered somewhat, especially with reference to the development of preapical bristles and costal spines.

Czerny (1924, 1927) mentioned that *B. fulviceps* may have indistinct preapical bristles on the hind tibiae, but that no costal spines are present. In the most recent revision of the North American Heleomyzidae, Gill (1962) stated that dorsal preapical bristles are absent in *Borboropsis*, and further mentioned that the costal spines are absent, or that they are present but obscure.

Because of apparent ambiguities concerning the character states of these features in *B. fulviceps*, it might well be that the above authors were dealing with more than one species or that the species is polymorphic or polytypic. To assess these possibilities, I examined specimens determined as *B. fulviceps* from most of the major North American museums. Based on the material before me, *B. fulviceps* is neither polytypic nor polymorphic for these characters. The preapical dorsal spine on the hind tibia, although small and hair-like, is still evident, but I found no evidence of costal spines. *B. steyskali*, on the other hand, has a definite dorsal bristle on the hind tibia and the costal spines are distinct, although the development of both structures is somewhat less than typical of heleomyzids in general.

The addition of *B. steyskali* further complicates other taxonomic issues of importance. Subsequent to his description of *Borboropsis*,

¹ The work reported in this paper was supported by NSF grant GB-20963 to the Coniferous Forest Biome, Ecosystem Analysis Studies, US/IBP; this is contribution no. 82.

Czerny (1924) described a second genus, *Oldenbergiella*, which is closely related to *Borboropsis*. According to Czerny's description, *Oldenbergiella* has costal spines and one species, *O. callosa* Czerny, has distinct preapical bristles on all tibiae. Furthermore, *B. steyskali* runs to *Oldenbergiella* rather than *Borboropsis* in Czerny's key (1927).

Gill (p. 512), gives one additional character for separating the genera in his key and discussion of *Oldenbergiella*, "This genus is likely to be confused only with *Borboropsis* Czerny, from which it can be distinguished by the absence of a bristle in the posterior portion of the mesopleuron." The validity of *Oldenbergiella*, in view of apparent overlaps with *B. steyskali*, is perhaps questionable. Further study, especially with the male postabdomen, will be necessary to resolve this question.

B. steyskali is placed in the genus *Borboropsis* because the mesopleuron has a bristle in the posterior portion, because of its close similarity to *B. fulviceps*, and because *Borboropsis* has priority.

Because specimens are rare, a more complete systematic study of the two genera is not yet possible. It would be desirable to compare Nearctic specimens with Palaearctic material with special reference to genitalia. Recognition of *B. steyskali* as a new species is justified in view of the differences already noted and in the key. This is particularly true of characters found on the male postabdomen.

BORBOROPSIS Czerny

Borboropsis Czerny, 1902: 256; 1924: 67; 1927: 21—Collin, 1943: 2—Gill, 1962: 511.

KEY TO THE SPECIES OF BORBOROPSIS

Costa with distinct spines, length 3–4 mm., male genitalia as in figure *a*, dorsal preapical bristle present on hind tibiae *steyskali* n. sp.
 Costal spines absent, length 2.4–3.1 mm., male genitalia as in figure *b*, preapical dorsal bristle on hind tibiae absent or weakly developed *fulviceps* (Strobl)

***Borboropsis steyskali* Mathis, new species**

DIAGNOSIS.—This species is closely related to *B. fulviceps*, but differs from it with respect to the characters mentioned in the key.

MALE.—Head from lateral view with large cheeks, cheek-eye ratio 1.7; anterior half of front yellow and haired, becoming black and generally bare posteriorly; fronto-orbital plates with 2 bristles, covered with grayish pollinosity; ocellar triangle also covered with grayish pollinosity; eyes round; face and cheeks whitish-yellow; oral vibrissae distinct, strongly developed; cheeks haired; first and second antennal segments reddish-yellow; second segment with prominent dorsomedial bristle; third segment black, subglobose, covered with whitish pubescence; aristae pubescent; palpi brownish-yellow.

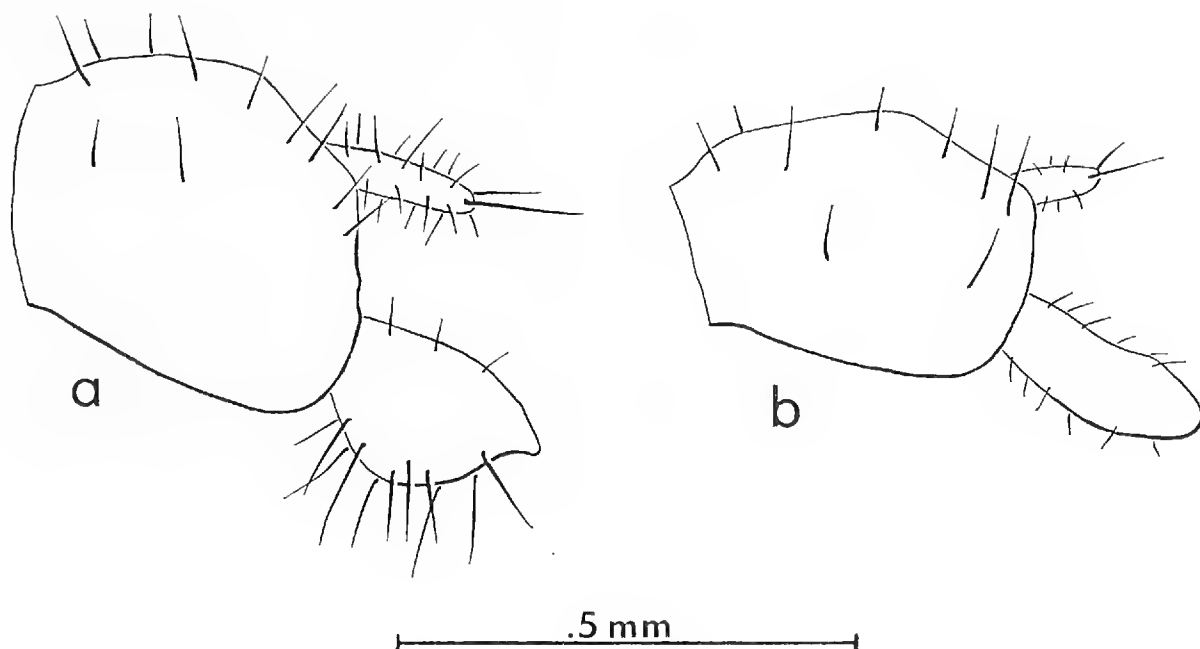


FIG. 1. Lateral view of epandrium, cercus, and surstylus. a. *Borboropsis steyskali*. b. *B. fulviceps*.

Thorax black; pollinosity of dorsum sparse, brownish-gray, becoming stronger and grayer on humerus, noto- and mesopleurae; acrostical hairs in 4 rows anteriorly, becoming stronger posteriorly and reduced to 2 rows; a pair of prescutellar bristles present; dorsocentrals 2 + 3, but only the posterior 2 pairs distinctly larger than dorsocentral hairs; 1 presutural bristle; 1 supra-alar bristle; 2 post-alar bristles; scutellum bare except for 2 pairs of lateral bristles; humerus haired with one bristle; notopleuron with 2 bristles on ventral margin; mesopleuron haired on posterior margin, 1 distinct posterodorsal bristle, 1 propleural bristle; sternopleuron with one posterodorsal bristle, a few hairs anterior to bristle.

Wings with costal spines distinct though small; hyaline.

Legs black to dirty yellow, becoming more yellow apically; fore coxae yellowed; mesotibiae with several ventral apical bristles; preapical bristle on hind tibiae present but small.

Abdomen generally black but yellowed marginally; male protandrium asymmetrical, terga of segments 6, 7, and 8 strongly displaced; andrium more symmetrical; epandrium from a lateral view subquadrate, posteroventral margin slightly drawn out; cerci bacilliform and hairy; surstyli rounded and enlarged ventrally, tapering and recurved toward apex, ventral and dorsomedial margin bearing several long bristles.

FEMALE.—Similar to male except for the female postabdomen.

DISTRIBUTION.—Oregon, March–May.

Holotype male, OREGON, LANE COUNTY, H. J. ANDREWS EXPERIMENTAL FOREST near BLUE RIVER, CLEARCUT AREA NUMBER L107, April 23, 1973, Rotary net, M. Mispagel collector, sample # (43-17), IBP Biome Survey—W. P. Nagel and G. Daterman. Allotype (female), Oregon, Lane County, H. J. Andrews Experimental Forest near Blue River.

Young age Doug Fir stand, number L105, March 27, 1973, Rotary net, M. Mispagel collector, sample # (41-13), IBP Biome Survey—W. P. Nagel and G. Daterman. Paratypes: 12 males, 6 females, same data as holotype and allotype except for the dates which go from the 27th of March through the 9th of May, 1973.

The holotype, allotype, and 2 paratypes will be deposited in the USNMNH (no. 72839); a male and female paratype will be deposited in the California Academy of Sciences, San Francisco; the Canadian National Collection, Ottawa; Washington State University, Pullman; and at Oregon State University, Corvallis. The remaining paratypes will remain in the collection of the author.

REMARKS.—The type specimens were all collected in a rotary trap in an insect survey being conducted by the International Biological Program, Coniferous Forest Biome.

I am pleased to dedicate this new species to my good friend and dipterist, George C. Steyskal, whose assistance is gratefully acknowledged.

BORBOROPSIS FULVICEPS (Strobl)

Anthomyza fulviceps Strobl, 1898: 269.

Borboropsis fulviceps (Strobl), Czerny, 1902: 256; 1924: 67; 1927: 22.

DIAGNOSIS.—This species is very similar to *B. steyskali* except as indicated in the discussion and key. The male andrium and cerci are of special importance and are illustrated in figure *b*.

DISTRIBUTION.—Holarctic.

SPECIMENS EXAMINED.—CANADA: Yukon Territory, Herchel I., 22 July 1971, W. R. M. Mason, 1 female; North West Territories, Muskox, 64°45' N., 108°10' W., 4 August 1953, J. G. Chillcott, 1 female, 2 males; British Columbia, Robson, 30 September 1949, H. R. Foxlee, 1 female; Saskatchewan, Otosquen, 12 September 1959, J. R. Vockeroth, 1 female, 1 male; Manitoba, Hudson Bay Road, mile 500, 3 August 1952, J. G. Chillcott, 1 female, Churchill, 30 July 1952, J. G. Chillcott, 1 female, Churchill, 25 August 1950, J. G. Chillcott, 1 male, Fort Churchill, 11 August 1952, J. G. Chillcott, 1 male; Quebec, Harrington Lake, Gatineau Park, 26 October 1960, G. E. Shewell, 1 female. UNITED STATES: Alaska, Matanuska, 28 September 1945, Rotary trap collection, J. C. Chamberlin, 1 male, 1 female; Alaska, Matanuska, 5 October 1945, J. C. Chamberlin, 1 female; Washington, Longmire, 27 June 1935, A. L. Melander, 1 male.

REMARKS.—This species is most readily distinguished from *B. steyskali* by differences in the male genitalia, absence of costal spines, weakly developed dorsal preapical bristles on the hind tibiae, and the reduced size. The species has only been rarely collected and nothing is known of its biology. It is interesting and perhaps significant that the Alaskan specimens were also collected in a rotary trap.

ACKNOWLEDGMENTS

I wish to thank the following institutions and individuals for permission to examine specimens: Washington State University, Dr. William J. Turner; The Canadian National Collection, Dr. B. V. Peterson; U. S. National Museum of Natural History, Mr. George C. Steyskal.

I also wish to thank Drs. John D. Lattin and Paul W. Oman for reviewing the manuscript and offering valuable comments and Dr. Bill Nagel for facilitating financial arrangements.

LITERATURE CITED

- COLLIN, J. E. 1943. The British species of Helomyzidae (Diptera). *Entomol. Mon. Mag.*, 79: 234-240; 241-251.
- GILL, G. D. 1962. The heleomyzid flies of America north of Mexico (Diptera: Heleomyzidae). *Proc. U. S. Natl. Mus.*, 113(3465): 495-603.
- CZERNY, L. 1902. Bemerkungen zu den Arten der Gattungen *Anthomyza* Fll. und *Ischnomyia* Lw. *Wien. Entomol. Ztg.*, 21: 249-256.
1924. Monographie der Helomyziden (Dipteren). *Abh. Zool.-Bot. Ges. Wien.*, 15(1): 1-166.
1927. Helomyzidae, Trichoscelidae, und Chiromyidae. [Fam.] 53a-53c, pp. 1-56 (= 1fg. 22). *In* Lindner, E. (ed.), *Die Fliegen der palaearktischen Region*. Vol. 5. Stuttgart.
- STROBL, G. 1898. Die Dipteren von Steiermark, IV. Theil. *Mitt. Naturwiss. Ver. Steiermark*, 34: 192-298.

SCIENTIFIC NOTE

Fumigation of museum specimens in oven-cooking bags.—Insect boxes of lightweight cardboard and designed for mailing provide no protection against museum pests. Damage during storage can be reduced by placing the boxes in polyethylene bags with crystals of paradichlorobenzene. Unfortunately the fumigant readily escapes through the bag wall and thereby creates a health hazard. Oven-cooking bags of Reynolon[®] film (heat stabilized polymer resin as used in Reynolds Brown-in-Bag[®] oven bags) minimize loss of the fumigant while retaining the desirable features of transparency and adaptable shapes and sizes. As a demonstration, 20 grams of paradichlorobenzene were placed in a 14 × 20 inch bag of each type, inflated, and closed with rubber bands. After 49 days no crystals or odor remained in the polyethylene bag, but only 1.8% of the weight of the crystals had been lost in the Reynolon film bag. This method of protection is also suitable for anthropological and art objects of wood, leather, fur, feathers, etc. Furthermore, Reynolon film bags retain the vapors of ethyl acetate, chloroform, and carbon tetrachloride, thus offering an improvement for the sweep-sampling technique described by Chemsak (1957, *J. Econ. Entomol.*, 50(4): 523). Reynolon film bags are available in several sizes from retail stores and in tube form from the manufacturer.—HOWELL V. DALY, *University of California, Berkeley*.

The *Hamotus* of Arizona

(Coleoptera: Pselaphidae)

DONALD S. CHANDLER

Department of Entomology, University of Arizona, Tucson 85721¹

Hamotus Aubé is a large, almost entirely neotropical genus, which has been little known from the United States. It was first recognized in Arizona with Raffray's (1896) correct placement of *Tyrus elongatus* Brendel in *Hamotus*. Fletcher (1932) added *H. opimus* in 1932. These two are the currently known species in the United States. Two more species from Arizona, *H. nodicollis* Raffray and *H. populus*, new species, can now be added to the list.

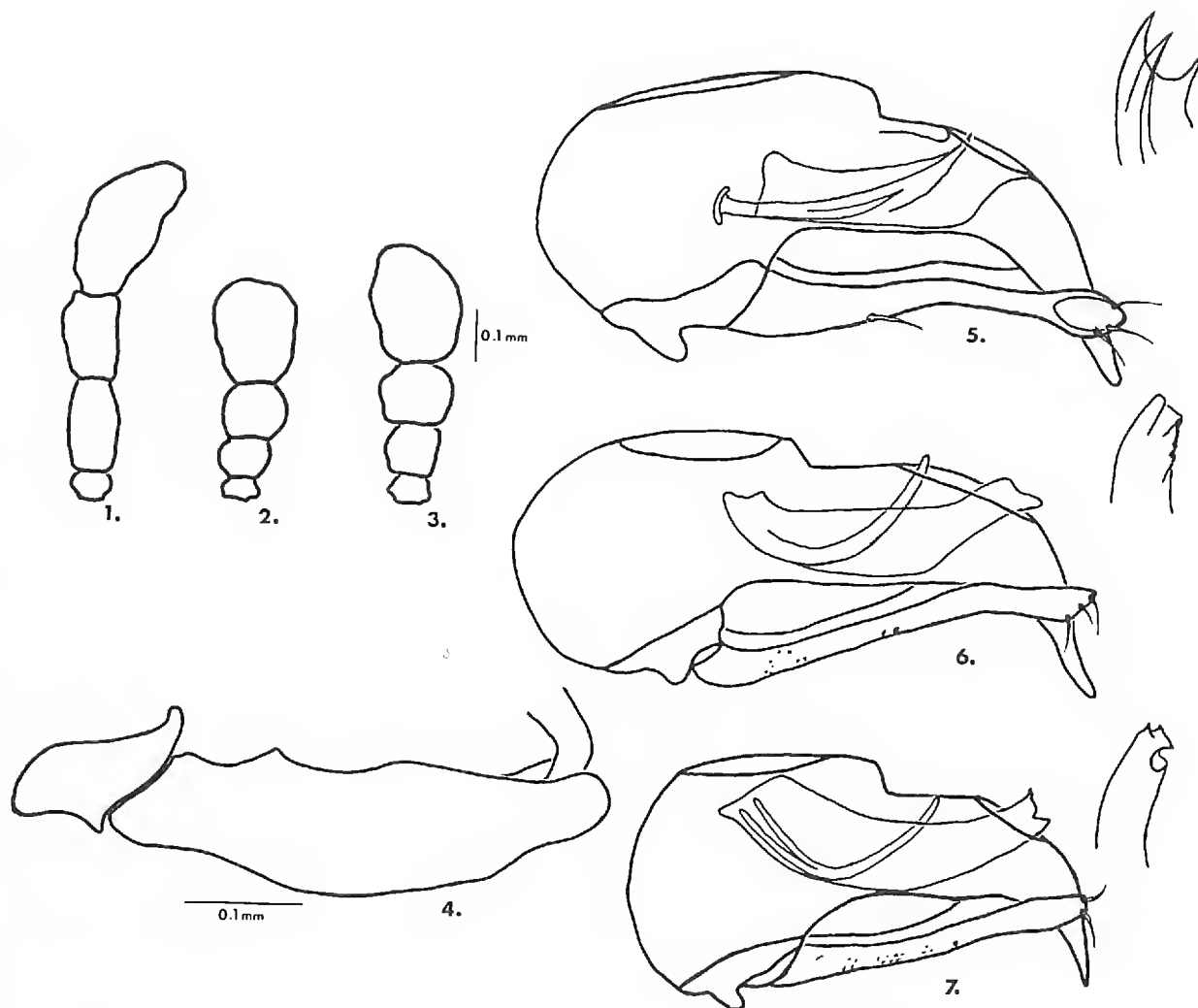
The Arizona species can be placed in Group XII, subgenus *Hamotoides*, by Park's (1942) key to Raffray's groups due to the presence of the antebasal sulcus and the large median fovea of the pronotum. *H. elongatus* keys out to *nodicollis* and is separated by the characters given in my key to the Arizona species. *H. populus* cannot be placed by Park's key, being distinct by having antennal segments IX and X similar in form and size, and more than three times as long as segment VIII.

The species in Arizona inhabit different altitudinal areas and can be identified by this difference. *H. nodicollis* is found in rotting cactus and white-throated woodrat nests in Arizona and Sonora and can be considered a desert associate. *H. elongatus* is found under bark of dead trees (all records are pine) above 6,000 feet in mountainous areas. *H. populus* was collected in the intermediate elevations under bark of dead cottonwood.

An unplaced female specimen, characterized by thick, white setae on the antennal club, represents either an extreme of *nodicollis* or a new species. It is interesting as it was probably collected in association with *Zootermopsis laticeps* (Banks) (Isoptera: Hodotermitidae) when an ultraviolet light was run in a cage containing *Zootermopsis*-infested wood from Patagonia, Arizona (W. L. Nutting).

I would like to thank D. C. Rentz of the Academy of Natural Sciences of Philadelphia for the loan of the lectotype of *H. elongatus*; K. W. Brown of the Peabody Museum of Natural History, Yale University; M. W. Sanderson of the Illinois Natural History Survey and K. Stephan of Tucson for the loan of their collections. Dr. F. G. Werner checked the manuscript, for which I am grateful.

¹ Current address: Department of Entomology, The Ohio State University, Columbus 43210.



FIGS. 1-7. Taxonomic characters of *Hamotus*. Fig. 1-3. Antennal segments VIII-XI. 1, *H. populus*; 2, *H. elongatus*; 3, *H. nodicollis*. Fig. 4. Protrochanter and profemur of male *H. elongatus*. Figs. 5-7. Left lateral view of male genitalia and dorsal view of penis. 5, *H. populus*; 6, *H. elongatus*; 7, *H. nodicollis*.

1 female, 12/16 August 1970; 2 females, 16/22 August 1970, UV trap, R. J. Shaw; 1 male, 29 July 1957, light, G. Butler. Pima County: 2 males, 10 mi. S.E. Mammoth, San Pedro River, 10 November 1971, under bark of dead cottonwood, D. S. Chandler. 1 female, Tucson, 8 August 1968, K. Stephan. Pinal County: 1 male, Mammoth, 17 November 1969, K. Stephan. MEXICO. *Sonora*.—1 male, 10 mi. E. Navajoa, 13 August 1969, blk. lt. trap, W. L. Nutting & F. G. Werner. The holotype to be deposited in the California Academy of Sciences. Paratypes in collections of K. Stephan, the University of Arizona and the author.

HAMOTUS (HAMOTOIDES) ELONGATUS (Brendel)

(Figs. 2, 4, 6)

Tyrus elongatus Brendel 1890: 239-240. (Type locality: Williams, Arizona).
Hamotus elongatus: Raffray 1896: 134. Bowman 1934. Park 1942: 308-309.

In Brendel's description of this species, he mentioned that the male profemur had a "small, sharp thorn on the basal, and a minute sharp

tubercle on the second third." However, this latter tubercle could not be found after examination of all available specimens and the lectotype. The femur is ridged somewhat at that point and may possibly be produced into a tubercle in some of the specimens Brendel saw. I have added a few details and measurements to Brendel's description.

Third segment of maxillary palpus with moderate groove through entire length; mandibles each with three teeth and a small tubercle; tergites I-IV margined, tergites I-III with two lateral foveae to a side, IV with one lateral fovea, V without foveae; sternites I-IV with single, large, deep lateral fovea to a side.

Redescribed male.—Santa Catalina Mountains, Arizona. Head 0.47 mm. long, width across eyes 0.43 mm., width across antennal insertions 0.25 mm.; 0.21 mm. from head base to median antennal fovea, vertexal foveae 0.07 mm. from median antennal fovea, 0.07 mm. from eyes; length and width antennal segments: VIII 0.04×0.07 mm., IX 0.08×0.10 , X 0.11×0.13 , XI 0.22×0.17 ; third segment of maxillary palpus 0.22 mm. long, 0.10 mm. wide. Pronotum 0.42 mm. long, 0.46 mm. wide at pronotal angles, angles 0.27 mm. from base, 0.40 mm. wide at base, apex 0.25 mm. wide; median fovea 0.08 mm. from base, 0.14 mm. from lateral foveae, lateral foveae 0.07 mm. from base. Basal foveae of elytron 0.06 mm. apart, elytron 0.21 mm. wide at base, 0.49 mm. wide near apex, 0.65 mm. long; width between lateral foveae of abdominal tergites: I 0.37 mm., II 0.38, III 0.37, IV 0.35; tergite V 0.15 mm. long, 0.28 mm. wide; width between lateral foveae of sternites: I 0.36 mm., II 0.47, III 0.46, IV 0.40; sternite V 0.34 mm. wide. Male profemora 0.40 mm. long, tubercle 0.09 mm. from base.

Distribution.—Through the mountains of southern Arizona and New Mexico. ARIZONA.—Cochise County: Rustlers Park, Chiricahua Mountains, 17 June 1973, under pine bark, D. S. Chandler. Graham County: Swift Trail, 7,400 ft., Pinaleno Mountains, 6 July 1973, under pine bark, T. P. Sluss & D. S. Chandler. Pima County: Santa Catalina Mountains, 7,000 ft., 5 April/23 May 1968, K. Stephan; 8,500 ft., 12 May 1948, A. A. Nichol; Bear Canyon, 25 January/29 March 1970, under pine bark, K. Stephan; Bear Canyon, 6,000 ft., 16 June 1970, 26 April 1973, under pine bark, D. S. Chandler. NEW MEXICO.—Lincoln County: Gallinas Mountain, T1S R11E, 7,000 ft., 1 July 1951, under bark of yellow pine, C. C. Hoff. Nogal Canyon, nr. Nogal, 7,200 ft., 5 June 1952, under bark, yellow pine log, Hoff & Parrack.

HAMOTUS (HAMOTOIDES) NODICOLLIS Raffray

(Figs. 3, 7)

Hamotus nodicollis Raffray 1883: 240. (Type locality: Mexico).

Hamotus (Hamotoides) nodicollis: Park 1942: 317; 1945: 413.

Castaneous, moderately dense, long pubescence; head subtruncate at base, eyes prominent, posterior emargination across one-third of eye, emargination with dense, long pubescence; vertexal foveae small, median antennal fovea larger and oval; third segment of maxillary palpus with moderate groove through entire length; mandibles each with four teeth; antennae with distinct, three-segmented club. Pronotum with small, prominent pronotal angles anterior to lateral foveae, apex truncate; median and lateral foveae large, densely pubescent; distinct transverse sulcus much narrower than median fovea. Elytron with two basal foveae; tergites

I-IV margined, I-III with two lateral foveae to a side, IV-V with one lateral fovea; sternites I-IV with single, large, deep, lateral fovea to a side. Male with protrochanter spined. Female without spine.

Redescribed male.—Tucson Mountains, Arizona. Head 0.45 mm. long, width across eyes 0.46 mm., width across antennal insertions 0.26 mm.; 0.24 mm. from head base to median antennal fovea, vertexal foveae 0.09 mm. from median antennal fovea, 0.07 mm. from eyes; length and width of antennal segments: VIII 0.04×0.07 mm., IX 0.10×0.10 , X 0.12×0.13 , XI 0.20×0.16 ; third segment of maxillary palpus 0.21 mm. long, 0.10 mm. wide. Pronotum 0.41 mm. long, 0.49 mm. wide at pronotal angles, angles 0.19 mm. from base, 0.47 mm. wide at base, apex 0.26 mm. wide; median fovea 0.10 mm. from base, 0.17 mm. from lateral foveae, lateral foveae 0.10 mm. from base. Basal foveae of elytron 0.15 mm. apart, elytron 0.22 mm. wide at base, 0.43 mm. wide near apex, 0.68 mm. long; width between lateral foveae of abdominal tergites: I 0.37 mm., II 0.45, III 0.44, IV 0.41; tergite V 0.20 mm. long, 0.32 mm. wide; width between lateral foveae of sternites: I 0.50 mm., II 0.56, III 0.51, IV 0.44; sternite V 0.39 mm. wide.

Distribution.—Through Arizonan and Sonoran desert areas into tropical Mexico. ARIZONA.—Gila County: Globe, 28 August 1952, light F. H. Parker. Pima County: Ariz.-Son. Desert Museum, 1/4 August 1962, lt. trap, W. L. Nutting & S. Oman. Colossal Cave Park, 18 April 1968, K. Stephan; 9 October 1971, 27 October 1971, 31 December 1971, in rotting saguaro, D. S. Chandler. 3 mi. S.W. Redington, 10 November 1971, in rotting saguaro, D. S. Chandler. Saguaro National Monument, 30 December 1972, in decayed saguaro, F. Werner. Silverbell, IBP Research Area, 10 mi. W. Marana, 13 October 1971, in rotting saguaro, D. S. Chandler. Tucson (Catalina Foothills) Den #2, *Neotoma* sp., 2 August 1962, W. L. Nutting & P. Mehlinger. Tucson Mountains, 15 February 1970, 21 March 1970, saguaro, K. Stephan. Pinal County: Boyce Thompson S. W. Arboretum, Superior, 14 September 1949, lt. trap, B. W. Benson. MEXICO. *Sonora*.—5 mi. W. Alamos, 14 August 1959, black light trap, W. L. Nutting & F. G. Werner. 11.5 mi. E. Alamos, 31 November 1972, in rotting Cardon, K. Stephan & D. S. Chandler. 13.5 mi. E. Alamos, 29 November 1972, under bark, K. Stephan & D. S. Chandler. 10 mi. E. Navajoa, 13 August 1959, black light trap, W. L. Nutting & F. G. Werner.

LITERATURE CITED

- BOWMAN, J. R. 1934. The Pselaphidae of North America. Privately published, Pittsburgh, 149 pp. (not seen).
- BRENDEL, E. & H. F. WICKHAM. 1890. The Pselaphidae of North America. Bull. Lab. Nat. Hist., State Univ. Iowa, 1: 216-304.
- FLETCHER, F. C. 1932. Undescribed North American species of Pselaphidae (Coleoptera), including a synopsis of the genus *Rhexidius* Casey. Canad. Entomol., 64: 29-35.
- PARK, O. 1942. A study in neotropical Pselaphidae. Northwestern Univ. Studies Biol. Sci. Med., No. 1, 403 pp.
1945. Further studies in Pselaphidae (Coleoptera) of Mexico and Guatemala. Bull. Chicago Acad. Sci., 7: 331-443.
- RAFFRAY, A. 1883. Pselaphides nouveaux ou peu connus. Revue D'Entomol., 2: 229-250.
1896. Notes synonymiques sur les Pselaphides. Ann. Soc. Entomol. France, 65: 131-137.

Lectotype designations of African bees of the genus *Ceratina* and allies

(Hymenoptera, Apoidea)

HOWELL V. DALY

University of California, Berkeley

Names proposed in the genus *Ceratina* for African species by C. T. Bingham, P. Cameron, H. Friese, M. F. Meunier, E. Strand, and J. Vachal lack designated types. The purpose of this paper is to validate 33 lectotype designations in anticipation of my monographic treatment of small carpenter bees of the genus *Ceratina* and its allies in Africa south of the Sahara and Madagascar. In each case the original author or subsequent reviser failed to designate a holotype, failed to indicate whether more than one specimen was examined, or referred ambiguously to a type among the syntypes. A list of 18 names based on single specimens is also included to document the existence of holotype specimens and their locations. The 51 designations below are intended to establish unequivocal primary type specimens for the names concerned. All species are discussed below as members of the genus *Ceratina* in which they were originally assigned. Wing length in millimeters was measured from the apex of the costal sclerite to the maximum curvature of the wing.

In each case the specimen, collection data, and original determination labels are consistent with the original description, type locality or localities, dates of collection, general character of the author's labels, and known repository for the type material. The choice of specimens is also consistent with the published indications of previous revisers, and their comments are noted in each case. Where both sexes were represented among the syntypes, males were favored as lectotypes because their taxonomic features are critical in the separation of species. The location of each lectotype is indicated by abbreviations given in the acknowledgments. Each type also has a red label with the indications: *Ceratina*, species, author, sex, lectotype or holotype, Howell V. Daly, 1973.

Twelve names from specimens of African *Ceratina* in the Brauns collection of the Transvaal Museum are included in the list of types published by the South African Museum's Association (Anonymous, 1958: 30-33). Of the twelve, seven are Brauns' unpublished manuscript names. Three of these were later described by Cockerell (1932: 272, 277, 278) from other specimens in the British Museum (*C. liliputana*,

male type No. 17B-255; *C. subulata*, male type No. 17B-314; *C. aloes* female lectotype designated below). Specimens bearing the remaining five names have red, handwritten labels stating that they are types of Friese's species. Dr. Brauns is known to have sent specimens to Friese for identification and description. However, not one of the alleged types of *Ceratina* in his collection has the characteristic determination label of Friese and the data on specimens bearing three of the names fail to match Friese's descriptions. In my judgment no evidence exists that the specimens in question were parts of the syntype series examined by Friese and in view of Recommendation 74D, I have chosen all the lectotypes for the species of Friese from the authenticated syntypes at the Zoological Museum in Berlin. Each of the designated specimens in Berlin has Friese's handwritten determination label, each usually has a red label of unknown origin with the imprint "Type" which often identifies the favored specimen, and each agrees in every detail with the original description.

I am greatly indebted to the following curators for their kind cooperation and assistance in pursuing this task: C. Jacot-Guillarmod and F. Gess, Albany Museum, Grahamstown (AM); R. W. Crosskey, I. H. H. Yarrow and G. Else, British Museum (Natural History), London (BMNH); J. Oehlke, Institut für Pflanzenschutzforschung Kleinmachnow (formerly Deutsches Entomologisches Institut), Eberswalde (DEI); C. O'Toole, University Museum, Hope Department of Entomology, Oxford (UM); P. Dessart, Institut Royal des Sciences Naturelles de Belgique (IRSNB); S. Kelner-Pillault, Museum National d'Histoire Naturelle, Paris (MNHN); L. Vari, Transvaal Museum, Pretoria (TM); E. Königsmann, Zoologisches Museum der Humboldt-Universität, Berlin (MNHU).

This research was supported in part by research grants from the National Science Foundation (GB-7933, GB-34089).

Lectotypes are designated for the following:

1. *aereola* Vachal, 1903: 383. Lectotype male; wing length, 4.9 mm. Labels: 1) pale green, printed "Bouyssoui, N'Doro, X-XI-98"; 2) white, written "aereola ♂ Vach."; 3) pale green, printed "Museum Paris, Coll. J. Vachal 1911"; 4) salmon, written "Holotype, *Ceratina aereola* Vachal, det. Y. Hirashima." Hirashima (1969: 651) comments, "In addition to the type series (2 ♀♀, 2 ♂♂) which is in the Paris Museum . . . The type of this species is the male." (MNHN)
2. *allodapoides* Strand, 1912: 282. Lectotype female; wing length, 5.3 mm. Labels: 1) blue, printed "Span. Guinea, Uelleburg, G. Tessman S. G."; 2) white, written "Ceratina allodapoides m ♀," printed "Strand det." (MNHU)

3. *aloes* Cockerell, 1932: 272. Lectotype female; wing length, 6.5 mm. Labels: 1) white, folded, written "Blaukrans, nr Calvinia, Nov. 17, L. O."; 2) white, Cockerell handwriting "Ceratina aloes Br ♀"; 3) white, printed "B.M. 1932-324, T. D. A. Cockerell." (BMNH)
4. *bouyssoui* Vachal, 1903: 383. Lectotype female; wing length, 9.3 mm. Labels: 1) white, printed "Lambarèn, X97"; 2) white, written "Ceratina bouyssoui ♀ Vach."; 3) green, printed "Museum Paris, Coll. J. Vachal 1911"; 4) salmon, written "Type"; 5) white, written "Megaceratina," printed "det. Y. Hirashima." This specimen commented on by Hirashima (1971: 254): ". . . I think, therefore, it should be regarded as the type." Labels 4 and 5 were placed on the specimen by him. (MNHN)
5. *braunsiana* Friese, 1905: 12. Lectotype female; wing length, 4.9 mm. Labels: 1) white, printed "Algoa Bay., Capland., Dr. H. Brauns," written "24 7 96"; 2) white, dashed border, written "Ceratina braunsiana ♀ Fr," printed "1904 Friese det." (MNHU)
6. *congoensis* Meunier, 1890: cci. Lectotype male; wing length, 4.0 mm. Labels: 1) white, written "Matadi, 21 Mars 1889"; 2) white, written "Ceratina congoensis Meunier ♂"; 3) white, written "Ceratina congoensis Meun. ♂, Type," printed "det. Vachal 1911"; 4) white, black line border, printed in red "Type." (IRSNB)
7. *daressalamica* Strand, 1911b: 18. Lectotype male; wing length, 3.7 mm. Labels: 1) blue, printed "D. O. Afrika, Daressalam, Pangani u. Hinterld, Regner S. G."; 2) white, written "Ceratina daressalamica m ♂," printed "Strand det." (MNHU)
8. *defeminata* Strand, 1911b: 20. Lectotype male; wing length, 4.9 mm. Labels: 1) blue, printed "Tanganyika-S. P. Reichard S."; 2) white, written "Ceratina defeminata m ♂," printed "Strand det." (MNHU)
9. *dentipes* Friese, 1914: 32. Lectotype male; wing length, 2.9 mm. Labels: 1) white, printed "Java, Buitzorg, Schmiedk."; 2) white, dashed border, written "Ceratina dentipes ♂ m Fr," printed "1900 Friese det." (MNHU)
10. *elongata* Friese, 1905: 14. Lectotype male; wing length, ca. 4.3 mm. Labels: 1) white, printed "D. O. Africa, Kigonsera, 1903"; 2) white, dashed border, written "Ceratina elongata ♂ Fr.," printed "1904 Friese det." (MNHU)
11. *emarginata* Friese, 1905: 12. Lectotype female; wing length, 5.1 mm. Labels: 1) white, "Capland, Willowmor, Dr. Brauns," written "15-6-1904"; 2) white, dashed border, written "Ceratina emarginata ♀ Fr.," printed "1904 Friese det." (MNHU)
12. *ericia* Vachal, 1903: 384. Lectotype female; wing length, 4.2 mm. Labels: 1) white, printed "Bata, 5 IX 98"; 2) blue, printed "Bouyssou, Congo"; 3) white, written "ericia ♀ Vach."; 4) pale green, printed "Museum Paris, Coll. J. Vachal 1911"; 5) red, printed "Type." (MNHN)
13. *harrarensis* Vachal, 1910: 532. Lectotype male; wing length, 4.4 mm. Labels: 1) blue, printed "Museum Paris, Harrar, Maurice de Rothschild, 1905"; 2) white, written, "Mars"; 3) white, written "Carat. Harrarandi Mars. No. 9"; 4) salmon, written, "Holotype, Ceratina harrarensis Vachal, 1909, det. Y. Hirashima." (MNHN)
14. *inermis* Friese, 1905: 8. Lectotype male; wing length, ca. 4.8 mm. Labels: 1) white, printed "Shilouvane, N. Transvaal, (Junod)," written "10.";

- 2) white, dashed border, written "Ceratina inermis ♂ Fr.," printed "1904 Friese det." (MNHU)
15. *labrosa* Friese, 1905: 11. Lectotype female; wing length, 5.9 mm. Labels: 1) white, printed "Capland, Willowmor, Dr. Brauns," written "9.6 1904"; 2) white, dashed border, written "Ceratina labrosa ♀ Fr.," printed "1904 Friese det." (MNHU)
16. *lativentris* Friese, 1905: 10. Lectotype male; wing length, 5.9 mm. Labels: 1) white, written "Madagask., Tolia, 03"; 2) white, dashed border, written "Ceratina lativentris ♂ Fr.," printed "1904 Friese det." (MNHU)
17. *lineola* Vachal, 1903: 385. Lectotype female; wing length, 4.6 mm. Labels: 1) gray, printed "Monteiro, Delagoa-Bay"; 2) quadrile, written "lineola Vach. ♀." (IRSNB)
18. *ludwigi* Strand, 1914: 174. Lectotype female; wing length, ca. 3.1 mm. Labels: 1) red, printed "Typus"; 2) white, written "Victoria, Kamerun, Lüdwigs"; 3) white, written "Ceratina ludwigi m ♀," printed "Strand det." (DEI)
19. *lunata* Friese, 1905: 10. Lectotype male; wing length, 4.8 mm. Labels: 1) white, printed "Shilouvane, N. Transvaal, (Junod)," written "12"; 2) white, dashed border, written "Ceratina lunata Fr.," printed "1904 Friese det." (MNHU)
20. *madecassa* Friese, 1900: 262. Lectotype male; wing length, 3.3 mm. Labels: 1) white, written "Madagask. Nossi-be, 17-XI-95, Voeltzkow"; 2) white, dashed border, written "Ceratina madecassa, ♂ Fr.," printed "1900 Friese det." (MNHU)
21. *minuta* Friese, 1905: 14. Lectotype male; wing length, 2.7 mm. Labels: 1) white, printed "D. O-Africa, Kigonsera, 1903"; 2) white, dashed border, written "Ceratina minuta ♂ Fr.," printed "1904 Friese det." (MNHU)
22. *moerenhouti* Vachal, 1903: 385. Lectotype female; wing length, 4.5 mm. Labels: 1) blue, printed "Vista (Congo), V. Moerenhout"; 2) white, black line border, printed in red "Type"; 3) white, written "moerenhouti ♀ Vach." (IRSNB)
23. *mucronata* Friese, 1905: 9. Lectotype male; wing length, 5.5 mm. Labels: 1) white, printed "Shilouvane, N. Transvaal (Junod)," written "12"; 2) white, dashed border, written "Ceratina mucronata ♂ Fr.," printed "1904 Friese det." (MNHU)
24. *nasalis* Friese, 1905: 8. Lectotype male; wing length, 5.9 mm. Labels: 1) white, written "Algoa Bay, Capland, 5 7 96," printed "Dr. Brauns"; 2) white, dashed border, written "Ceratina nasalis ♂ Fr.," printed "1904 Friese det." (MNHU)
25. *nigriceps* Friese, 1905: 11. Lectotype female, wing length, 4.3 mm. Labels: 1) white, written "Cradock, Capland"; 2) white, dashed border, written "Ceratina nigriceps ♀ Fr.," printed "1904 Friese det." (MNHU)
26. *opaca* Friese, 1905: 13. Lectotype male; wing length, 5.5 mm. Labels: 1) white, printed "Algoa Bay, Capland."; 2) white, dashed border, written "Ceratina opaca ♂ Fr.," printed "1904 Friese det." (MNHU)
27. *penicillata* Friese, 1905: 9. Lectotype male; wing length, 4.5 mm. Labels: 1) white, printed "Shilouvane, N. Transvaal, (Junod)," written "10"; 2) white, dashed border, written "Ceratina penicillata ♂ Fr.," printed "1904 Friese det." (MNHU)

28. *personata* Friese, 1905: 14. Lectotype female; wing length, 3.9 mm. Labels: 1) white, printed "W. Africa, Old Calabar, 190 (*date incomplete*), v. Stefennelli"; 2) white, dashed border, written "Ceratina personata ♀ Fr.," printed "1904 Friese det." (MNHU)
29. *subelongata* Strand, 1912: 283. Lectotype male; wing length, 4.6 mm. Labels: 1) blue, written "Sp. Guinea, Uelleburg, 6-8 1908, G. Tessman"; 2) white, written "Ceratina subelongata m ♂," printed "Strand det." (MNHU)
30. *sulcata* Friese, 1905: 13. Lectotype male; wing length, ca. 5.1 mm. Labels: 1) white, printed "Willowmore, Capland, Dr. Brauns," written "10.1 1902"; 2) white, dashed border, written "Ceratina sulcata ♂ Fr.," printed "1904 Friese det." (MNHU)
31. *tanganyicensis* Strand, 1911a: 137. Lectotype male; wing length, 4.8 mm. Labels: 1) blue, printed "Tanganyika-S., P. Reichard S."; 2) white, written "Ceratina tanganyicensis m ♂," printed "Strand det." (MNHU)
32. *tibialis* Friese, 1905: 9. Lectotype male; wing length, 4.1 mm. Labels: 1) white, printed "Algoa-Bay, Capland"; 2) white, dashed border, written "Ceratina tibialis ♂ Fr.," printed "1904 Friese det." (MNHU)
33. *truncata* Friese, 1905: 11. Lectotype male; wing length, 5.9 mm. Labels: 1) white, printed "Capland, Willowmore, Dr. Brauns," written "9.6 1904"; 2) white, dashed border, written "Ceratina truncata ♂ Fr.," printed "1904 Friese det." (MNHU)

The following names were based on single specimens. The location of the holotype is indicated in parenthesis:

1. *acutipyga* Strand, 1911b: 22, female; wing length, 5.0 mm (MNHU).
2. *bicarinata* Cameron, 1905: 198, female; wing length, 5.3 mm (AM).
3. *caesia* Vachal, 1903: 385, female; wing length, 3.5 mm (IRSNB).
4. *foveifera* Strand, 1911b: 27, female; wing length, 3.3 mm (MNHU).
5. *furcilinea* Strand, 1911b: 25, female; wing length, 4.4 mm (MNHU).
6. *guineae* Strand, 1912: 283, male; wing length, 6.0 mm (MNHU).
7. *guineana* Strand, 1911b: 19, male; wing length, 4.9 mm (MNHU).
8. *langenburgiae* Strand, 1911b: 15, male; wing length, 4.8 mm (MNHU).
9. *loa* Strand, 1912: 286, male; wing length, 4.6 mm (MNHU).
10. *nassiinsignita* Strand, 1912: 285, male; wing length, 4.1 mm (MNHU).
11. *nyassensis* Strand, 1911b: 26, female; wing length, 3.6 mm (MNHU).
12. *penicilligera* Strand, 1911b: 17, male; wing length, 5.3 mm (MNHU).
13. *rothchildiana* Vachal, 1910: 531, female; wing length, 5.3 mm (MNHN).
14. *senegalensis* Strand, 1911b: 24, female; wing length, 3.6 mm (MNHU).
15. *taborae* Strand, 1911b: 21, female; wing length, 5.1 mm (MNHU).
16. *togana* Strand, 1911b: 16, female; wing length, 4.9 mm (MNHU).
17. *viriditincta* Strand, 1911b: 23, male; wing length, 4.4 mm (MNHU).
18. *vittata* Bingham, 1912: 382, male (sex misdetermined, description includes male-specific characters); wing length, 4.6 mm (UM).

LITERATURE CITED

- ANONYMOUS. 1958. A list of zoological and botanical types preserved in collections in Southern and East Africa. Vol. 1. Zoology, Part 1: 1-147. Published by the South African Museum's Association, Pretoria.

- BINGHAM, C. T. 1912. South African and Australian Aculeate Hymenoptera in the Oxford Museum. *Trans. Entomol. Soc. Lond.*, 60(2): 375-383.
- CAMERON, P. 1905. On the Hymenoptera of the Albany Museum, Grahamstown, South Africa. *Rec. Albany Mus.*, 1(4): 185-244.
- COCKERELL, T. D. A. 1932. Descriptions and records of bees. CXXXVI. *Ann. Mag. Nat. Hist.*, (10) 10: 267-278.
- FRIESE, H. 1900. Hymenoptera von Madagaskar. *Abh. Senckenb. naturforsch. Ges.*, 26(2): 259-268.
1905. Die Keulhornbienen Afrikas. Genus *Ceratina* (Hym.). *Wien. Entomol. Ztg.*, 24(1-2): 1-18.
1914. Die Bienen fauna von Java. *Tijdschr. Entomol.*, 57: 1-61.
- HIRASHIMA, Y. 1969. Synopsis of the genus *Pithitis* Klug of the world (Hymenoptera: Anthophoridae). *Pac. Insects*, 11(3-4): 649-669.
1971. *Megaceratina*, a new genus of bees of Africa (Hymenoptera, Anthophoridae). *J. Nat. Hist.*, 5: 251-256.
- MEUNIER, M. F. 1890. (communication in meeting of 26 November 1890). *Bull. Soc. Entomol. Fr.*, pp. cci-ccii.
- STRAND, E. 1911a. Faunistische und systematische Notizen über afrikanische Bienen. *Wien. Entomol. Ztg.*, 30(6-7): 135-159.
- 1911b. Neue afrikanische Bienen der Gattungen *Sphcodes* und *Ceratina*. *Arch. Naturgesch.*, 77(1, 4 suppl.): 12-27.
1912. Zoologische Ergebnisse der Expedition des Herrn G. Tessmann nach Süd-Kamerun und Spanisch-Guinea. Bienen. *Mitt. Zool. Mus. Berlin*, 6(2): 265-312.
1914. Beschreibung je einer neuen *Allodape*- und *Ceratina*- Art aus Kamerun, nebst biologischen Bemerkungen (Hym.). *Entomol. Mitt.*, 3(6): 173-176.
- VACHAL, J. 1903. Hymenopteres du Congo Francais. *Ann. Soc. Entomol. Fr.*, 72: 358-400.
1910. Collections recueillies par M. le Baron Maurice de Rothchild dans l'Afrique orientale, Insectes Hyménoptères: Mellifères. *Bull. Mus. Natl. Hist. Nat. (Paris)*, 15: 529-534.

RECENT LITERATURE

SCABIES—by Kenneth Mellanby. E. W. Classey Ltd., reprint, VI + 81 pp. \$3.50 (paperback). U. S. distributor, Entomological Reprint Specialists, P. O. Box 77971, Dockweiler Station, Los Angeles, California 90007.

Primarily of historical interest, this small volume which was first published during World War II has been reissued virtually unchanged. The text includes chapters on the anatomy and bionomics of the itch mite, as well as discussions of the pathology, control and prevention of scabies.—Editor.

Six New Nearctic Species of the Genus *Friesea*

(Collembola: Poduromorpha)

KENNETH CHRISTIANSEN AND PETER BELLINGER

*Grinnell College, Grinnell, Iowa 50112 and
California State University, Northridge 91324*

In connection with a study of the collembolan fauna of North America we have found a number of new species of *Friesea*, mostly from the western third of the country, which has an unusually rich fauna of this genus. Descriptions of these new species are needed for the publication of an analysis of chaetotaxy in the North American members of the genus.

Measurements of types and other representative specimens are given in Table 1.

***Friesea cera* Christiansen and Bellinger, new species**

(Fig. 1a-d)

Light blue, paler ventrally, eye patches black; fourth antennal segment with partly withdrawn unlobed apical bulb and with four apical and two basal setae dorsally; eyes 8 + 8; maxilla (fig. 1a) with larger lamella simple, smaller lamella with three very small teeth; mandible (fig. 1b) with seven or eight teeth; tibiotarsus without clavate tenent hairs; unguis (fig. 1d) untoothed; tenaculum bidentate; mucrodens (fig. 1c) one and one-half to two times length of longest anal spine, with distinct mucro fused to dens; three curved anal spines, subequal in length to inner edge of unguis; integumental granulation uniform, moderately coarse; body setae smooth, acuminate; maximum length 0.7 mm.

Holotype (sex undetermined) from Conard Ecological Research Area, Jasper County, Iowa, mixed deciduous forest litter (B. Dubach). Additional material examined from Essex County, Massachusetts; Middlefield, Hartford County, Connecticut; Shingletown, and Bear Meadows, Pennsylvania; and Volo, Illinois.

Among similar Nearctic species of *Friesea* (with 8 + 8 eyes and three anal spines), *F. sublimis* Macnamara is distinguished by its clavate abdominal setae, the mucro being separate from the dens, and striking differences in chaetotaxy; *F. mirabilis* (Tullberg) has a relatively shorter mucrodens with a hook-shaped mucro.

***Friesea millsii* Christiansen and Bellinger, new species**

(Fig. 1e-j)

Pale blue with pigment in scattered granules; eye patches dark; fourth antennal segment (fig. 1i) fused with third dorsally, separated ventrally, with deeply with-

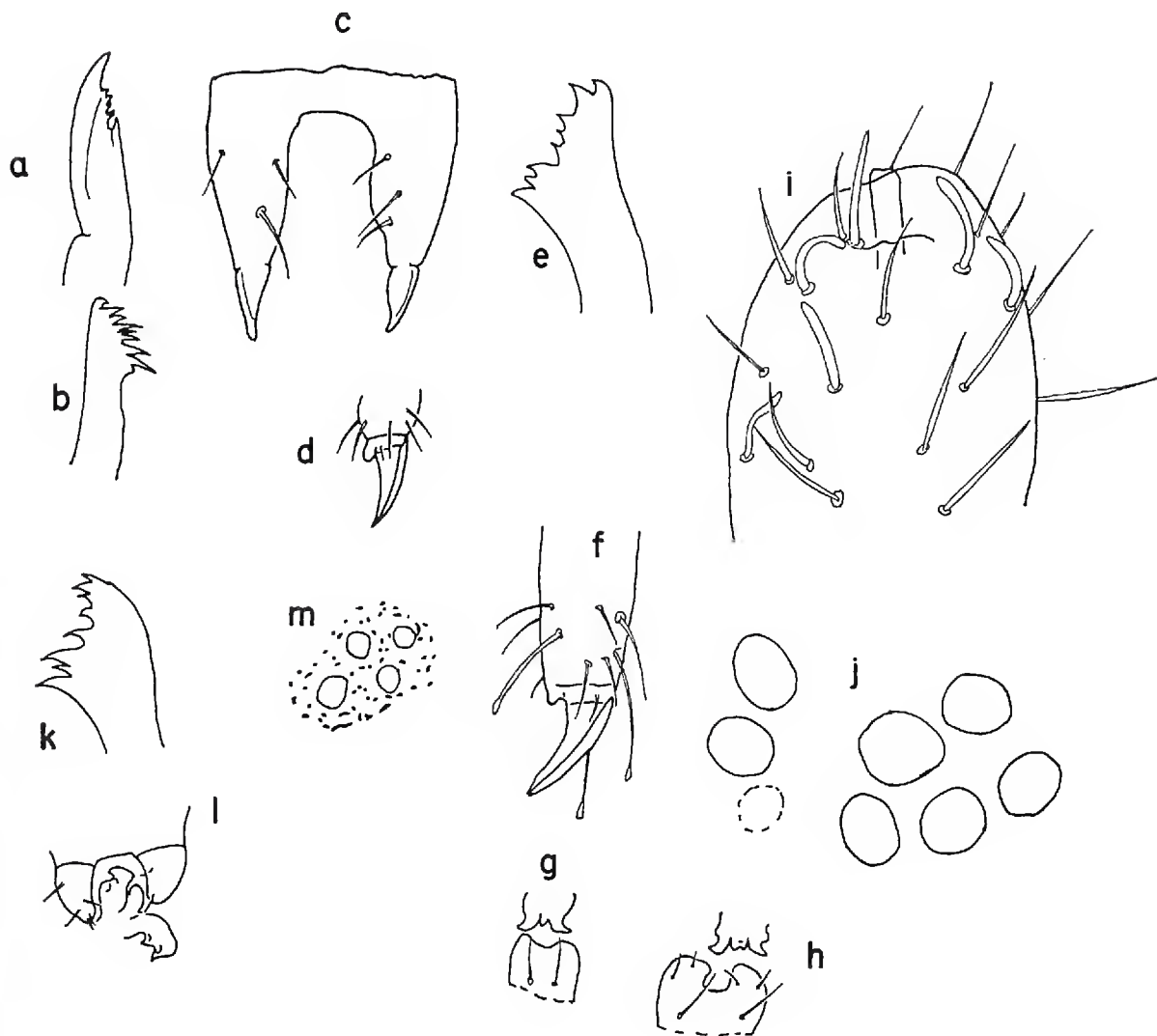


FIG. 1. *Friesea cera*, *F. millsii* and *F. quinta*. All structures at 1000 \times magnification unless noted otherwise. Fig. 1a-d. *F. cera*, structures of holotype. (a) maxilla, (b) mandible, (c) mucrones and dentes, dorsal aspect, (d) hind foot complex (450 \times); Fig. 1e-j. *F. millsii*, structures of type specimens. (e) mandible, (f) forefoot complex (450 \times), (g, h) mucrodens and tenaculum of two individuals, (i) apex of fourth antennal segment, (j) eyepatch, variable eye shown dotted. Fig. 1k-m. *F. quinta*, structures of type specimens. (k) mandible, (l) mucrodens and tenaculum (500 \times) (m) eyepatch (500 \times).

drawn unlobed apical bulb, and with one basal and five distal blunt setae dorsally; eyes (fig. 1j) 7 + 7 to 8 + 8; maxilla with large lamella unidentate, smaller lamella tridentate; tibiotarsus (fig. 1f) with three weakly clavate tenent hairs; unguis with minute subapical inner tooth, without lateral teeth; tenaculum (fig. 1g, h) unidentate or with rudimentary second tooth; mucrodens (figs. 1g, h) knoblike, fused to manubrium, with three minute setae (absent in some individuals); furcula two-thirds to three-fourths length of longest anal spine; five straight anal spines as long as inner edge of unguis set on short papillae; integumental granulations ranging from about eight micra in diameter anteriorly to seventeen micra posteriorly; body setae smooth, acuminate except longest setae on fifth and sixth abdominal segments which are clavate; maximum length 0.9 mm.

TABLE 1. Measurements of taxonomically important structures of *Friesea* species. All measurements were made with an ocular micrometer, and are in millimeters. Measurements are middorsal lengths; "total length" is measured from the apex of the labrum to the end of the abdomen, and may not correspond to the sum of individual segment lengths because of dorsal curvature of the body. Not all specimens could be measured; blank spaces in the table correspond to features which could not be measured accurately because of distortion. For each species, the first set of measurements represents the holotype. Succeeding measurements for *F. cera* are of specimens from Shingletown, Pennsylvania; Essex County, Massachusetts; Bear Meadows, Pennsylvania (2 specimens); and Volo, Ill. (3 specimens). Succeeding measurements for other species are of paratypes.

Species	Total Length	Antenna	Head	Thoracic Segments			Abdominal Segments						Posterior Tibiotarsus	Posterior Unguis	
				I	II	III	I	II	III	IV	V	VI			
<i>F. cera</i>	.574	.07	.147	.07	.14	.18	----	----	----	----	----	----	----	.033	.0044
	.451	.066	.089	.024	.047	.052	.047	.042	.038	.038	.028	.024	.02	.0066	
	.357	.047	.089	.033	.038	.042	.028	----	----	----	.028	.019	.015	.0066	
	.335	.052	.099	.020	.042	.042	.038	.033	.056	----	----	----	----	.019	.0066
	.348	.056	.085	----	.037	.033	.024	.024	.024	.033	.022	.020	.013	.0044	
	.422	.052	.108	.029	.031	.044	.024	.026	.024	.037	.033	.026	.018	.0066	
	.330	.038	.085	.022	.029	.026	.022	.024	.024	.029	.022	.020	.018	.0066	
.296	.026	.079	.022	.029	.031	.024	.022	.022	.026	.018	.015	.013	.0066		
<i>F. millsii</i>	.528	.067	.125	.022	.055	.073	.051	.049	.042	.046	.033	.033	.024	.0088	
	.470	.055	.092	----	----	----	----	----	----	----	----	----	----	----	
<i>F. quinta</i>	.653	.080	.127	.061	.066	.066	.070	.061	.066	.061	.047	.038	.028	.0044	
	.595	.070	.122	.033	.061	.066	.066	----	----	.061	.052	.047	.029	.0066	
	.672	.075	.127	----	----	----	----	----	----	----	----	----	.026	----	
	.758	.075	.141	.047	.061	----	----	----	----	----	.048	.053	----	----	
<i>F. wilkeyi</i>	.509	.089	----	.029	.029	.035	----	----	----	----	.026	.033	.024	.0088	
	.442	.113	.075	----	----	----	----	----	----	----	----	.024	.018	.0066	
	.432	----	----	----	----	----	----	----	----	----	----	----	.020	.0088	
	.490	.080	.099	----	----	----	----	----	----	----	----	----	.022	.0088	
	.394	.061	.085	----	----	----	----	----	----	----	.024	.024	.020	.0066	
.480	.075	.094	----	----	----	----	----	----	----	----	----	.020	.0088		
<i>F. fara</i>	.672	.089	.141	----	----	----	----	.075	.056	.070	.042	.047	.029	.011	
	.691	.061	.141	.056	.066	.085	.047	.061	.070	.061	.047	.038	.033	.013	
	.672	.075	.136	.033	.070	----	----	----	----	.070	.047	.047	.031	.011	
	.643	.080	.122	.038	.085	.080	.080	.080	.075	.075	.052	.047	.035	.0088	
	.480	.075	.127	.038	.028	.042	.042	.042	.038	.042	.038	.033	.026	.0088	
	.797	.089	.174	.022	.048	.055	.031	.042	----	----	.046	.051	.037	.013	
	.701	.075	.155	.042	.080	.094	.080	.075	.056	.052	.052	.047	.033	.0084	
<i>F. polla</i>	.480	.070	.108	.040	.044	.044	.037	.033	.040	.042	.024	.020	.033	.0088	
	.432	.061	.099	.033	.044	.048	.037	.022	.026	.031	.026	.026	.020	.0088	
	.490	.066	.108	.024	.048	.057	.031	.035	.033	.044	.031	.031	.020	.0088	

Holotype (sex undetermined) and three paratypes from Bighorn National Forest, Sheridan County, Wyoming, elevation 8,000 ft., litter from open pine woods, August 7 (K. Christiansen).

The furcula in this species is variable but always extremely reduced. *F. millsii* is distinguished from other Nearctic species with five anal

spines by its clavate posterior body setae; the generally similar European species *F. mauriesi* Cassagnau differs in having eight anal spines.

***Friesea quinta* Christiansen and Bellinger, new species**

(Fig. 1k-m)

White with scattered blue pigment granules dorsally, eye patches darker, partially subdivided; fourth antennal segment with deeply withdrawn unlobed apical bulb, and with three distal and one basal blunt seta dorsally; eyes 4 + 4 (fig. 1m) or 5 + 5; larger maxillary lamella unidentate, smaller lamella with about seven small teeth; tibiotarsus with longest dorsal seta truncate, others acuminate; unguis untoothed; tenaculum (fig. 1l) bidentate; furcula (fig. 1l) without mucro, and with dens sharply demarcated from manubrium, subequal in length to anal spines, and bearing three dorsal setae; five straight, stout anal spines subequal in length to inner edge of unguis; integument moderately coarsely granulate; body setae acuminate, smooth; maximum length 0.8 mm.

Holotype (sex undetermined) and four paratypes from Wheeler Peak, Taos County, New Mexico, under aspen bark, July 2, 1955 (K. Christiansen).

This species resembles *F. nauroisi* Cassagnau, which differs in having 6 + 6 eyes, a relatively much shorter dens, and distinct chaetotaxy. *F. pentacantha* Mills is also similar, but has 8 + 8 eyes and only a single dental seta.

***Friesea wilkeyi* Christiansen and Bellinger, new species**

(Fig. 2)

White except for black eyes; fourth antennal segment (fig. 2c) with deeply withdrawn unlobed apical bulb, and with four distal and two basal blunt setae dorsally; eyes 2 + 2; maxilla with large lamella untoothed, small blade with about four obscure teeth (fig. 2b); mandible (fig. 2a) with six teeth; tibiotarsus (fig. 2f) with short acuminate tenent hairs; unguis with small subapical inner tooth, without lateral teeth; tenaculum (fig. 2d) unidentate; furcula (fig. 2d) with mucro fused to dens, mucrodens about three-fourths as long as anal spines; two straight anal spines (fig. 2e), slightly shorter than inner edge of unguis; integumentary granules varying in diameter from about six micra on second thoracic tergum to about fifteen micra on sixth abdominal segment; body setae acuminate, smooth or minutely serrate; maximum length 0.9 mm.

Holotype (sex undetermined) from Coalinga, Fresno County, California, juniper litter, March 19, 1955 (H. L. Wilson); five paratypes from Wharton Canyon, near Coalinga, Fresno County, California, juniper litter, January 22, 1958 (H. L. Wilson).

R. F. Wilkey (unpublished) first recognized and described this species. It is similar to *F. polla*, new species and *F. mistrali* Rapoport and Rubio (with 3 + 3 eyes) from Chile, but differs from both in eye number and structure of the furcula.

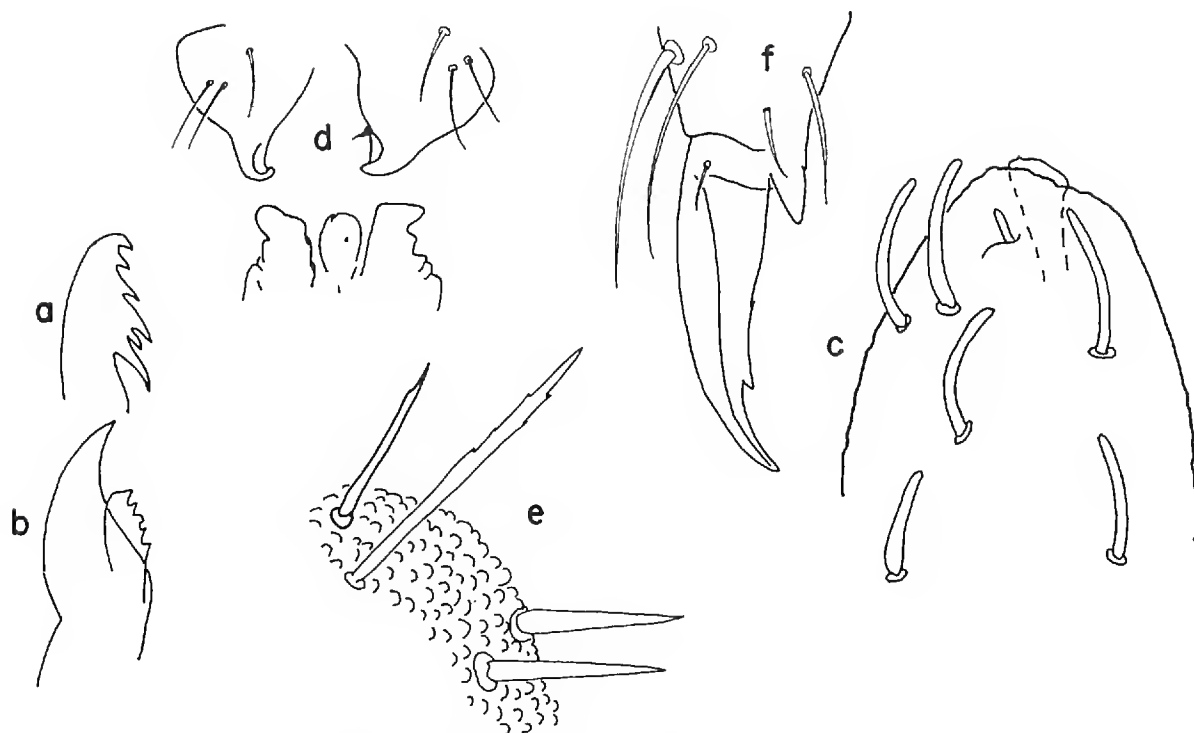


FIG. 2. *Friesea wilkei*. All figures at 1000 \times magnification, after drawings of type specimens by R. F. Wilkey. (a) mandible, (b) maxilla, (c) apex of fourth antennal segment, acuminate setae omitted, (d) mucedens and tenaculum, dorsal aspect, (e) apex of abdomen, showing anal spines, (f) hind foot complex.

Friesea fara Christiansen and Bellinger, new species

(Fig. 3a-e)

Color unknown (only cleared specimens available); fourth antennal segment weakly separated from third on ventral side, with an unlobed, deeply withdrawn apical bulb, and with one basal and four apical blunt setae dorsally; eyes 8 + 8; maxilla (fig. 3b) with large lamella tridentate, small lamella obscure but apparently with four teeth; mandible (fig. 3a) with six teeth; tibiotarsus (fig. 3d) with eight to ten clavate setae, one greatly enlarged apically; unguis untoothed; tenaculum (fig. 3c) varying from untoothed to weakly bidentate; furcula (fig. 3c) without mucro, with dens reduced to knob half as long as anal spines and bare or with up to three minute setae; six straight anal spines 1.2 to 1.5 times as long as inner edge of unguis (fig. 3e); integument moderately coarsely granulate, diameter of granules from twelve to fourteen micra; body setae smooth, acuminate except for one pair of long, weakly clavate setae on the fourth, fifth, and sixth abdominal segments, and a second strongly clavate pair on the sixth abdominal segment; fourth and fifth abdominal segments strongly plurichaetotic; maximum length 0.8 mm.

Holotype (sex undetermined) and six paratypes from Farallon Islands, California, September 23, 1951 (R. L. Usinger).

This is the only known plurichaetotic species of *Friesea*, and the only Nearctic species with six anal spines. In number of eyes and anal spines and the structure of the furcula, it resembles the European species *F.*

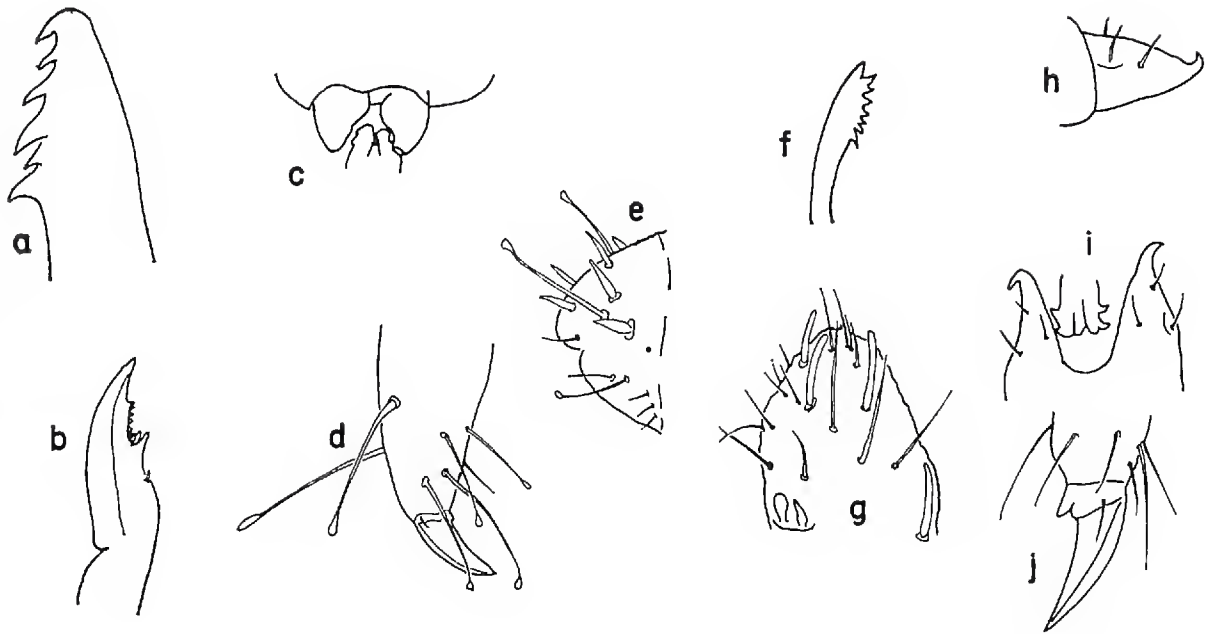


FIG. 3. *Friesea fara* and *F. polla*. Figures at 1000 \times magnification unless noted otherwise. Fig. 3a–e. *F. fara*, structures of type specimens. (a) mandible, (b) maxilla, (c) mucrodens and tenaculum (500 \times), (d) hind foot complex (500 \times), (e) sixth abdominal segment, lateral aspect (250 \times). Fig. 3f–j. *F. polla*, structures of type specimens. (f) mandible, (g) fourth antennal segment, (h) mucrodens, lateral aspect, (i) mucrodens, dorsal aspect, (j) hind foot complex.

handschini Kseneman, which has no clavate tibiotarsal or abdominal setae.

***Friesea polla* Christiansen and Bellinger, new species**

(Fig. 3f–j)

Color unknown (only cleared specimens available); fourth antennal segment (fig. 3g) weakly separated from third on ventral surface, with deeply withdrawn, unlobed apical bulb, with one basal and two or three distal blunt setae dorsally; eyes 8 + 8; large maxillary lamella with a single inner tooth, small lamella with three or four teeth; mandible (fig. 3f) with eight teeth; tibiotarsus (fig. 3j) with tenent hair acuminate; unguis without teeth; tenaculum (fig. 3i) with 2 + 2 teeth; mucrodens (fig. 3h, i) subequal in length to anal spines, with small hook-like mucro partially separated from the dens; two straight anal spines, subequal in length to inner edge of unguis; integument moderately coarsely granulate; all body setae smooth, acuminate; maximum length 0.7 mm.

Holotype male and three paratypes from Pollock Pines, El Dorado County, California, oak leaf litter, April 5, 1959 (J. R. Smith).

This species resembles *F. wilkeyi* in the number and structure of the anal spines, but is distinguished by the furcal structure and eye number. *F. polla* also resembles the Antarctic species *F. grisea* (Schäffer), which differs in having clavate tenent hairs.

DISPOSITION OF TYPES

The holotypes of all species described here will be deposited in the Museum of Comparative Zoology, Harvard University. Paratypes of *F. wilkeyi*, *F. fara*, and *F. polla* will be deposited in the collection of the California Department of Agriculture, Sacramento.

ACKNOWLEDGMENTS

Much of the work done on this paper was made possible by a grant to Grinnell College from the Sloan Foundation. We would like to thank Dr. R. F. Wilkey, who was responsible for making most of the California material available to us.

LITERATURE CITED

- CASSAGNAU, P. 1958. Les espèces européennes du genre *Friesea*. Bull. Soc. Hist. nat. Toulouse, 93: 17-29.
- MACNAMARA, C. 1920. A new species of *Friesea* (Collembola). Canad. Ent., 53: 125-129.
- MASSOUD, Z. 1967. Monographie des Neanuridae. Biol. Amer. austr., 3: 7-399.

SCIENTIFIC NOTE

***Ceratismicra campoplegicis* Burks, a hyperparasite of *Perilitus coccinellae* (Shrank) (Hymenoptera: Chalcididae, Braconidae).**—A single adult specimen of *Hippodamia convergens* Guerin-Meneville was collected from a white fir branch [*Abies concolor* (Gord. & Glend.) Lindl.] near Lake Edson, El Dorado Co., California on 12 July 1969. A cocoon of *Perilitus coccinellae* (Shrank) was found attached to its abdomen. The beetle was placed in rearing and a single male hyperparasite, *Ceratismicra campoplegicis* Burks (determined by B. D. Burks, U. S. National Museum) emerged on 28 July 1969. *C. campoplegicis* has been previously reared from cocoons of different Ichneumonidae but this is the first report of its occurrence from a braconid primary parasite (B. D. Burks, personal communication). This rearing also represents the first report of a chalcidid hyperparasite on *P. coccinellae* (personal communication, K. S. Hagen, Division of Biological Control, University of California, Berkeley).

Portions of this study have been funded by Environmental Protection Agency Grant #5 ROLE P-00814-05.—F. M. STEPHEN, *Division of Biological Control, University of California, Berkeley, 94720.*

**Ant Larvae of the Subfamily Dolichoderinae:
Second Supplement**

(Hymenoptera: Formicidae)

GEORGE C. WHEELER AND JEANETTE WHEELER

*Laboratory of Desert Biology, Desert Research Institute,
University of Nevada System, Reno 89507*

Subsequent to the publication of our first supplement on the ant larvae of the subfamily Dolichoderinae (1966) we have collected or received from other myrmecologists so much additional material that it has become necessary to publish another supplement, increasing the count of species studied by 20%. The additional larvae described here agree with our original characterization of the Dolichoderinae (1951: 207), with the exception of *Dolichoderus scabridus* Roger, which has paxilliform labial palpi.

DOLICHODERUS Lund

REVISION: In our generic characterization (1951: 172) the second sentence should read: A pair of ventrolateral bosses frequently present on the prothorax.

DOLICHODERUS (DICERATOCLINEA) SCABRIDUS Roger

Lengths (through spiracles) 2.5 and 6 mm; straight length 1.9 and 4.2 mm. Similar to *D. (H.) taschenbergi* (1951: 173) except as follows. T2 and T3 more swollen. Body hairs numerous on thorax and few on venter of AI. Of two types: (1) 0.025–0.03 mm long, simple, slender, flexuous, without alveolus and articular membrane; (2) about 0.048 mm long, stouter, with alveolus and articular membrane, a few on each somite. Cranium transversely subelliptical. Head hairs 0.05–0.075 mm long, slender, flexuous and numerous (about 200). Labrum subtrapezoidal, narrowed ventrally, width four times the length; anterior surface with 2 sensilla and a few oblique rows of spinules; ventral border with 6 sensilla; posterior surface with 8 sensilla. Maxillary palp a skewed peg with 5 sensilla; galea represented by 2 slightly raised sensilla. Labium small and feebly bilobed; palp a skewed peg with 4 sensilla; an isolated sensillum between each palp and opening of sericteries. Hypopharynx with minute spinules in short subtransverse rows. (Material studied: numerous larvae from New South Wales, Tahmoor, 28-XII-1966, courtesy of Rev. B. B. Lowery.)

DOLICHODERUS (HYPOCLINEA) AUSTRALIS E. André

Length (through spiracles) about 3.1 mm; straight length about 2.4 mm. Probably very similar to *D. (H.) taschenbergi* (1951: 173) except in the following details. Spiracles on AVIII vestigial. Body hairs 0.006–0.018 mm long, numerous on venter of T1, longest and most numerous on AX. Head with flattened dorsal

areas less distinct. Head hairs shorter (0.006–0.013 mm long). Labrum with 2 sensilla on anterior surface and 4 sensilla on ventral surface. Mandibles with apical tooth straighter. Maxillary palp a raised cluster of 4 sensilla; galea 2 slightly raised sensilla. Labial palp a raised cluster of 4 sensilla; an isolated sensillum between each palp and opening of sericteries. (Material studied: 4 semipupae from South Australia, Lofty Range 1500 ft, Morialta Reserve, 1-III-1969, courtesy of Rev. B. B. Lowery.)

DOLICHODERUS (HYPOCLINEA) GERMAINI Emery

Length (through spiracles) about 8.2 mm; straight length about 5 mm. Similar to *D. (H.) taschenbergi* (1951: 173) except as follows. Very short and stout; no lateral welt on T1. Body hairs 0.005–0.03 mm long; very few (mostly on venter of T1). Maxillae with a few minute spinules in encircling rows; palp a slightly raised cluster of 3 sensilla. Labium with minute spinules, isolated or in short rows; palp a slightly raised cluster of 4 sensilla. Hypopharynx with a few minute spinules. (Material studied: 4 larvae from Brazil, Utiariti, 325 m, Rio Papagalo, MT., VIII-1961, courtesy of Dr. K. Lenko.)

IRIDOMYRMEX Mayr

REVISION: Our generic characterization (1951: 184) should be changed to read: Body slightly curved. Anus ventral or posteroventral. Body and head hairs usually minute. Head moderately large. Antennae small.

IRIDOMYRMEX MELLEUS Wheeler

(Fig. 3)

Length (through spiracles) about 1.8 mm, straight length about 1.4 mm. Stout; dorsal profile long and C-shaped; ventral feebly sigmoid; a middorsal boss on AI; AX with a small projection posterior to the anus. Anus posteroventral. Leg and wing vestiges present. Spiracles small, those on AI largest. Integument with minute spinules in transverse rows, most numerous and prominent on venter of anterior somites and dorsum of posterior somites. Body hairs sparse, short and generally distributed. Of 2 types: (1) 0.025–0.036 mm long, on dorsal and lateral surfaces, bifid, the branches short to long; (2) 0.008–0.025 mm long, simple, most numerous on ventral surface of T1. Cranium about a third broader than long, broadest dorsally, suboctagonal in anterior view. Antennae large, each with 3 minute sensilla. Head hairs few, 0.013–0.025 mm long, simple. Labrum about a third broader than long, bilobed, erectile; each lobe with 1 sensillum on anterior surface, 1 on ventral border and with 1 plus a few short rows of minute spinules on posterior surface. Mandibles feebly sclerotized, slightly longer than broad, subtriangular in anterior view, apical tooth small and blunt, with one small subapical tooth, posterior surface with coarse denticles; mandibles erectile. Maxillae adnate; palp a slight elevation with 5 sensilla; galea a short cone with 2 sensilla. Labium small; anterior surface with minute spinules in short transverse rows; palp a slight elevation with 5 sensilla; opening of sericteries a short transverse slit. Hypopharynx densely spinulose, spinules arranged in rows, rows

grouped in 2 subtriangles which have their bases near the middle. (Material studied: numerous larvae, courtesy of Dr. R. Lavigne; in pith chambers of *Cecropia peltata* on forest floor, 2-VII-1970, El Verdi Field Sta., Loquilla Forest, Puerto Rico.)

This is the only species we have seen with erectile mandibles and labrum.

The remaining species of *Iridomyrmex* are compared with *I. pruinus* (1951: 185); only differences are given here.

IRIDOMYRMEX CONIFER Forel

Length (through spiracles) about 3 mm; straight length about 2.8 mm. Spiracles largest on T3 and A1, remainder small. Integument with minute spinules in numerous short arcuate rows. Body hairs 0.005–0.025 mm long. Cranium sub-circular. Head hairs few and minute (about 0.001 mm long). Labrum breadth 3 times length; bilobed; each lobe with 2 sensilla on anterior surface and one on ventral border; entire posterior surface with a few sensilla and with minute spinules. Mandibles with apical tooth more prominent, straighter and longer. Maxillary and labial palps represented by clusters of 5 sensilla each. (Material studied: 2 larvae from Western Australia, Blackwood River near Nannup, 18-XII-1969, courtesy of Rev. B. B. Lowery.)

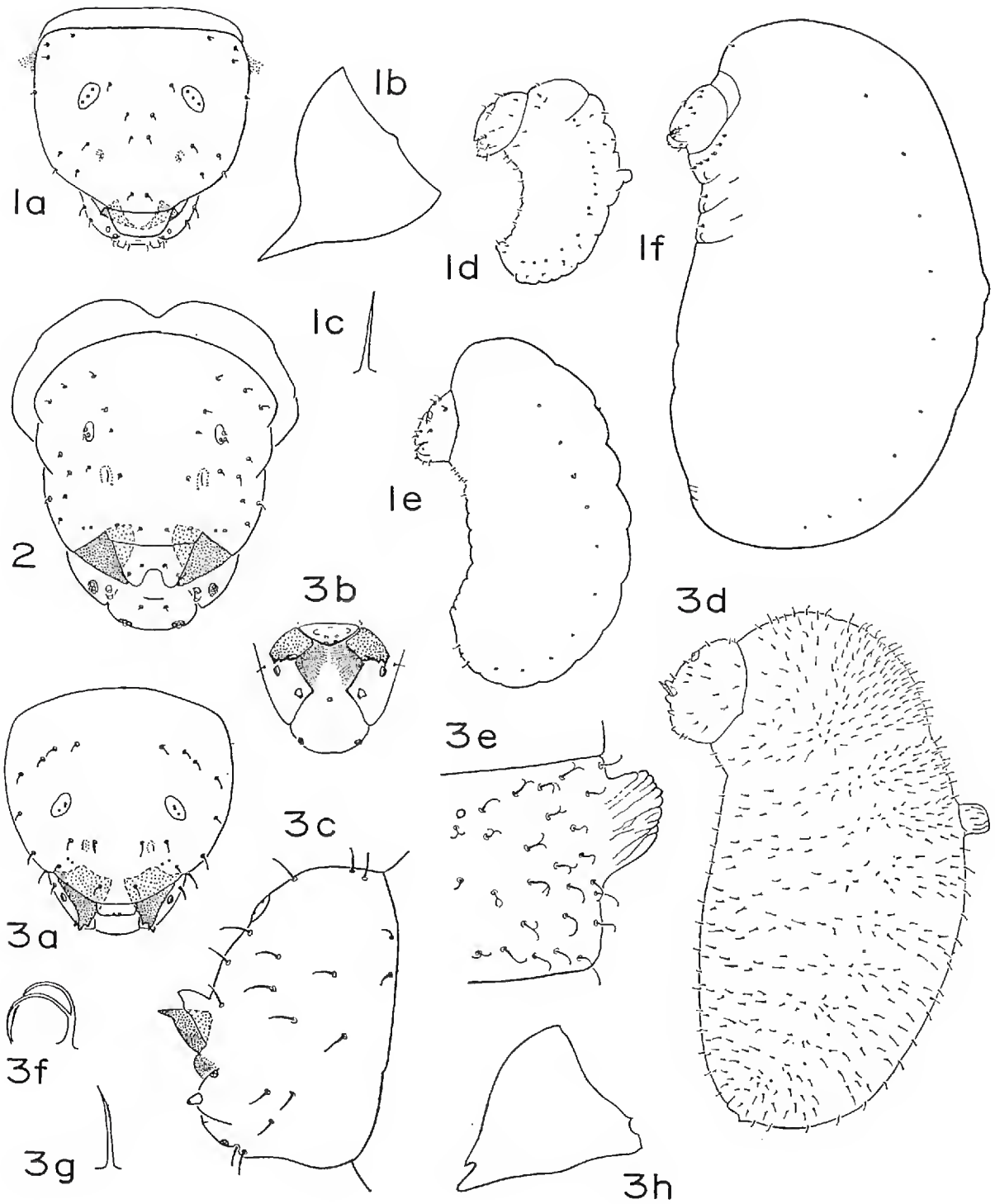
IRIDOMYRMEX DETECTUS F. Smith

Length (through spiracles) about 2.9 mm; straight length about 2.7 mm. Body stouter; dorsal profile longer; ventral shorter and more nearly straight. Head and anus ventral. Integument with minute spinules, isolated or in short rows on posterior somites and ventral surface of anterior somites. Body hairs 0.008–0.016 mm long, mostly on T1 and AX. Dorsal cranial outline a smooth curve; integument spinulose, spinules of moderate size and isolated or in short subparallel transverse rows. Head hairs few, 0.013–0.025 mm long. Labrum narrow; distinctly bilobed; each lobe with minute spinules in short rows and 3 sensilla ventrally on anterior surface, with 2 sensilla and several minute spinules on ventral border, and with a few short rows of minute spinules medially and 3 sensilla on the posterior surface. Mandibles with apical tooth more prominent and sharp-pointed. Maxillae lobose. Labial palp a rounded knob. (Material studied: 10 larvae from Queensland, St. George, 6-I-1966, courtesy of Rev. B. B. Lowery.)

IRIDOMYRMEX GLABER Mayr

Length (through spiracles) about 3.9 mm; straight length about 3.0 mm. Body short, stout and subovoidal; head applied to ventral surface below anterior end; anus posteroventral. Entire integument spinulose, spinules minute and in short transverse rows ventrally and posteriorly, some isolated spinules laterally. Body hairs moderately numerous and generally distributed, minute (about 0.003 mm long). Dorsal outline of cranium broadly curved; integument with short rows of minute spinules. Head hairs more numerous but still few. Mandibles with larger apical tooth. Maxillary and labial palps represented by clusters of 3 sensilla each.

YOUNG LARVA: Length (through spiracles) about 1.4 mm. Body stouter and



FIGS. 1-3. Fig. 1. *Forelius foetidus*: a, head in anterior view, $\times 107$; b, left mandible in anterior view, $\times 303$; c, body hair, $\times 677$; d, very young larva in side view, $\times 35$; e, young larva in side view, $\times 35$; f, mature larva in side view, $\times 35$. Fig. 2. *Iridomyrmex nitidus*: head in anterior view, $\times 72$. Fig. 3. *Iridomyrmex melleus*: a, head in anterior view, $\times 111$; b, mouth parts in anterior view with mandibles and labrum erected, $\times 111$; c, head in side view with mandibles and labrum erected, $\times 133$; d, larva in side view, $\times 47$; e, dorsal portion of first abdominal somite showing boss in lateral view, $\times 133$; f and g, two types of body hairs, $\times 533$; h, left mandible in anterior view, $\times 370$.

outlines straighter, but with 6 distinct middorsal bosses, one each on T2 and AI-AV. Thirteen feebly differentiated somites. Spinules more prominent on posterior end. Body hairs 0.002-0.015 mm long, longest ventrally. Otherwise similar to mature larva.

Material studied: numerous larvae from New South Wales, DeBurgh's Bridge, Lava Cove, Sydney, 26-V-1966, courtesy of Rev. B. B. Lowery.)

IRIDOMYRMEX NITIDUS Mayr

(Fig. 2)

Length (through spiracles) about 4.9 mm; straight length about 3.4 mm. Body stouter. Spiracles on AVIII vestigial. Integument of venter of anterior somites and dorsum of posterior somites with minute spinules, isolated or in short rows. Body hairs 0.001-0.025 mm long, with a slight concentration around AI spiracle. Cranium subquadrangular and with a bilobed flattened dorsal portion. Antennae slightly elevated, each with 3 small sensilla, bearing a spinule each. Head hairs shorter (0.006-0.012 mm long) and more numerous. Labrum width twice length, bilobed, each lobe with 2 hairs on anterior surface, with 2 median sensilla on ventral border and with 3 or 4 sensilla on posterior surface; entire posterior surface spinulose, spinules minute and in subtransverse rows. Mandibles with breadth equal to length; apical tooth moderately sclerotized and base feebly sclerotized; anterior surface of base spinulose, spinules minute and in short rows; apical portion narrowed, tapering only slightly; apex round-pointed or with rounded tip and a small subapical medial tooth. Maxillae adnate; palp a slightly raised, heavily sclerotized base with 5 sensilla; galea a boss with 2 sensilla. Labial palp a heavily sclerotized knob with 5 sensilla; an isolated sensillum between each palp and opening of the sericteries. (Material studied: numerous larvae from New South Wales, Mt. Mullens, Murwillumbah, 2-IX-1966, courtesy of Rev. B. B. Lowery.)

IRIDOMYRMEX VIRIDIAENEUS Viehmeyer

Length (through spiracles) about 6.2 mm; straight length about 5 mm. Body with dorsal profile long and C-shaped ventral short and nearly straight; head and anus ventral. Entire integument spinulose, spinules minute and in transverse rows. Body hairs sparse, more numerous ventrally. Of two types: (1) 0.013-0.056 mm long, simple, with fine tip; (2) 0.025-0.05 mm long, with a few fine denticles near tip. Cranium subtriangular in anterior view, a fourth broader than long. Head hairs twice as numerous and shorter (0.006-0.013 mm long). Labrum 1½ times as broad as long; bilobed, each lobe with 2 sensilla and 1 minute hair on the anterior surface, with minute spinules on ventral border, and with 4 or 5 sensilla in a medial cluster posteriorly; entire posterior surface with minute spinules in transverse subparallel rows. Mandibles nearly as broad as long and with the medial border erose. Maxillary palp a heavily sclerotized cluster of 5 sensilla; galea a sclerotized knob with 2 sensilla. Labial palp a slightly raised cluster of 5 sensilla; an isolated sensillum between each palp and opening of sericteries, the latter a wide transverse slit. (Material studied: 5 larvae from South Australia, 8 miles SW Morgan, courtesy of Rev. B. B. Lowery.)

FORELIUS Emery

ADDITION to our generic characterization (1966: 729): A mid-dorsal boss on AII.

FORELIUS FOETIDUS (Buckley)

(Fig. 1)

MATURE LARVA: Length (through spiracles) about 2.3 mm; straight length about 1.6 mm. Plump, chunky and turgid; dorsal profile long and C-shaped; ventral profile feebly sigmoid; a low middorsal boss on AII; both ends broadly rounded; head and anus ventral. Leg, wing and gonopod vestiges present. Spiracles small; diameter of AI greatest, diminishing posteriorly. Entire integument spinulose, spinules minute and isolated or in short transverse rows. Body hairs very few, minute (0.007–0.013 mm long), simple, most numerous on venter of T1. Cranium subhexagonal, with a depressed transverse dorsal band. Antennae large, slightly raised, each with 3 sensilla, each bearing a spinule. Head hairs few, simple and minute (about 0.013 mm long). Labrum short, broad, feebly bilobed: each lobe with 2 sensilla on anterior surface and 2 on posterior surface; entire posterior surface sparsely spinulose, spinules minute and isolated or in short transverse rows. Mandibles very feebly sclerotized, subtriangular in anterior view, base broad, apex sharp-pointed. Maxillae appearing adnate, with apex rather broadly round-pointed; palp a cluster of 5 sensilla; galea represented by 2 sensilla. Labium with ventral border paraboloidal, a few minute spinules near opening of sericteries; palp a slightly elevated cluster of 5 sensilla; an isolated sensillum between each palp and opening of sericteries, the latter a short transverse slit. Hypopharynx densely spinulose, spinules in rows, rows grouped in 2 subtriangles which have their bases near middle.

YOUNG LARVA: Length (through spiracles) about 1.7 mm. Similar to mature larva except as follows. Body more slender; segmentation more distinct. Diameter of spiracles on AI much greater than remainder which are minute. Body hairs about 0.001 mm long.

VERY YOUNG LARVA: Length (through spiracles) about 0.9 mm. Similar to young larva except as follows. Body much more slender; head nearly diameter of body and on anterior end; 10 distinct somites; boss on dorsum of AII very distinct; posterior end narrowly rounded. Anus ventral and with a distinct posterior lip. Body hairs shorter (about 0.008 mm).

Material studied: numerous larvae from Arizona, Organpipe Cactus National Monument, 1600 ft, 10-IV-1968, G. C. and J. Wheeler collection # 108.

LITERATURE CITED

- WHEELER, G. C., AND J. WHEELER. 1951. The ant larvae of the subfamily Dolichoderinae. *Proc. Entomol. Soc. Wash.*, 53: 169–210.
1966. The ant larvae of the subfamily Dolichoderinae: supplement. *Ann. Entomol. Soc. Amer.*, 59: 726–732.

SCIENTIFIC NOTES

Parasitization of *Malacosoma* larvae by Tachinidae in coastal California (Lepidoptera: Lasiocampidae; Diptera).—During studies of insects associated with coast live oak, *Quercus agrifolia* Nee, I collected large larvae of the Pacific tent caterpillar, *Malacosoma constrictum* (Hy. Edwards) and western tent caterpillar, *M. californicum* (Packard), from and around oaks on the campus of California State University, Hayward. I fed them fresh oak leaves which were first thoroughly scrutinized to eliminate parasite eggs. When cocoons were spun, each was placed within a 4 oz glass jar with a loosely-attached lid to permit air circulation. When a parasitoid larva emerged, the resulting puparium was transferred to a vial in which was placed a slightly moistened piece of paper towel. Flies emerged from 45% of these puparia.

No parasitoids resulted from 90 larvae collected in 1970 or 60 collected in 1971. Results for 1972 appear in Table 1; 51% of 139 larvae were parasitized. High proportions of parasitization by Tachinidae are somewhat unusual in *Malacosoma* larvae. Bess (1936, Ann. Entomol. Soc. Amer., 29: 593–613) reported 23% parasitization of *M. disstria* Hubner larvae and Kulman (1965, J. Econ. Entomol., 58: 66–70) found up to 39% of *M. americanum* (F.) parasitized, both in areas of high host density. In my study area, *Malacosoma* larvae increased from moderate to high density during the 3 years, so it is possible that the rise in parasitism represents a delayed numerical response to increasing host numbers. Alternate hosts are doubtless important in maintaining such a high density of parasitoids.

Two species of Tachinidae were recovered: *Compsilura concinnata* (Meigen), a parasite of European origin that has been recorded from over 200 hosts including several *Malacosoma* (Witter and Kulman, 1972, Univ. Minnesota Agr. Expt. Sta. Tech. Bull., 289) and *Chaetogaedia monticola* (Bigot), which likewise has been reared from several *Malacosoma* (Stehr and Cook, 1968, Bull. Smithson. Inst., 276; Witter and Kulman, 1972). Both flies parasitized *M. constrictum* and *californicum* in approximately equal numbers, but all 18 *Chaetogaedia* were reared from host larvae collected away from foliage, presumably searching for cocooning sites on tree trunks or surrounding litter. *Compsilura* emerged from host larvae collected both on and off foliage, and it reached peak numbers somewhat earlier than did *Chaetogaedia*. Turnock (1961, Can. Dept. Forest. Bi-M. Prog. Rep., 17:

TABLE 1. Parasitism of *Malacosoma* larvae by Tachinidae, Hayward, California 1972.

Date	Host larvae	<i>Compsilura</i>	<i>Chaetogaedia</i>
8 Apr	35	13 (37%)	1 (3%)
15 Apr	20	8 (40%)	3 (15%)
22 Apr	62	30 (48%)	4 (6%)
26 Apr	15	2 (13%)	6 (40%)
10 May	7	0	4 (57%)

2) noted spatial differences in parasitism by Sarcophagidae on *M. disstria* pupae. It is possible that such spatial and temporal differences as I report here may permit coexistence of both species of Tachinidae on the same host species.—DAVID J. HORN, *Department of Entomology, The Ohio State University, Columbus, 43210.*

***Apocephalus borealis* Brues parasitic upon *Vespula* spp. (Diptera: Phoridae; Hymenoptera: Vespidae).**—During 1971 and 1972, larvae, pupae and adults of a phorid fly, *Apocephalus borealis* Brues, were recovered from three species of yellowjackets in northern California. Specimens were kindly identified by Dr. W. W. Wirth (U. S. National Museum). The parasites were obtained from two ground nesting species, *Vespula pensylvanica* (Saussure) and *V. vulgaris* (L.), and the aerial nesting species, *V. arenaria* (F.).

In his recent revision of North American phorids, Borgmeier (1963, *Stud. Entomol. (n.s.)*, 6: 1–256) reported that *A. borealis* had been reared from "*Vespula*?" in Minnesota and from the spider, *Latrodectus mactans* (F.) in British Columbia. Other New World species of this widespread genus are parasitic on various species of ants and one parasitizes the cantharid beetle, *Chauliognathus fallax* Germar, in South America.

Large numbers of wasps were collected in cone traps placed directly over the ground nest openings. When the nest appeared vacated, it was dug up and examined. Lesser numbers of yellowjackets were trapped in cages baited with tuna cat food. Samples of *V. arenaria* were taken from an aerial nest.

Parasitized yellowjackets were observed in a very lethargic state, slowly crawling about on the floor of the cage or lying on their back or side with legs quivering. These affected wasps were closely pursued by other wasps which attacked and often dismembered them. Social wasps instinctively remove dead or dying members from their nests. However, I could not determine if the antagonistic behavior toward the weakened individuals was due to their parasitized condition. Last instar larvae emerged from affected wasps through the thoracic membranes, mainly in the cervical region. The maximum number observed to emerge from a single wasp was eight. Dissection of lethargic wasps revealed that most larvae had developed in the thoracic haemocoel, but fly larvae were occasionally found in the abdominal cavity. Upon pupation, the larvae turned light brown and attached themselves to the substrate. Adult flies emerged 2–4 days later.

Apocephalus borealis is apparently active throughout the yellowjacket season. Reared specimens were recovered from *V. pensylvanica* workers and from excavated nests from July to December and from *V. vulgaris* workers and a *V. arenaria* nest in July and August. In four *V. pensylvanica* nests, all collected near Martinez, California, approximately 5% of the yellowjackets were parasitized. Only one or two parasitized yellowjackets were caught in the baited cone traps even though large numbers of individuals were trapped. This observation suggests that *A. borealis* females confine their activities to the yellowjacket nest. The oviposition habits of other phorids suggests that *A. borealis* females lay their eggs primarily on yellowjacket larvae or teneral adults. Females of *A. borealis* are equipped with a flat, heavily sclerotized, lanceolate ovipositor which might be used to puncture the integumental membranes of the yellowjacket.

Borgmeier (1963) lists Muir Wood, Marin County and Gasquet, Del Norte

County in the California distribution of *A. borealis*. I have recovered material from San Rafael, Mill Valley (Marin County) and El Cerrito, Point Molate and Martinez (Contra Costa County).—FRANKLIN ENNIK, *State Department of Public Health, Berkeley, 94704*.

ZOOLOGICAL NOMENCLATURE

Required six-months' notice is given of the possible use of plenary powers by the International Commission on Zoological Nomenclature in connection with the following names listed by case number:

Announcement A. (n. s.) 90

(see *Bull. Zool. Nomencl.* 30, part 1, 6th July 1973)

- 1958. Correction of homonymy of DREPANIDAE in Insecta and Pisces.
- 2008. Suppression of *Macgillivraya* Grote, 1894 (Insecta, Collembola).
- 2009. Validation of *Haematopinus eurysternus* Denny, 1842 (Insecta, Anoplura).
- 2017. Suppression of *Rhopalidia* Lepeltier, 1836 (Insecta, Hymenoptera).
- 2023. Suppression of *Formica maxima* Moore, 1842 (Insecta, Hymenoptera).
- 2025. Suppression of *Daristane* Walker, 1859 (Insecta, Lepidoptera).
- 2026. Type-species for *Crinocerus* Burmeister, 1839 (Insecta, Hemiptera).
- 2028. Type-species for *Onycholyda* Takeuchi, 1938 (Insecta, Hymenoptera).

Announcement A. (n. s.) 91

(see *Bull. Zool. Nomencl.* 30, part 2, 10th October, 1973)

- 2027. Designation of a neotype for *Pieris virginiensis* Edwards, 1870 (Insecta, Lepidoptera).
- 2028. Designation of a typespecies for *Onycholyda* Takeuchi, 1938 (Insecta, Hymenoptera).
- 2029. Designation of lectotype for *Psednura longicornis* Sjöstedt, 1920 (Insecta, Orthoptera).
- 2033. Suppression of *Sceptrophorus* Foerster, 1856 (Insecta, Hymenoptera).
- 2035. Suppression of *Drosophila carinata* Grimshaw, 1901 (Insecta, Diptera).
- 2036. Suppression of *Hydrophorus jaculus* Fallen as type-species of *Hydrophorus* Fallen, 1823, in favour of *H. nebulosus* Fallen. (Insecta, Diptera.)
- 2037. Designation of a type-species for *Oscinella* Becker, 1909 (Insecta, Diptera).
- 2038. Suppression of *Leucospis gallica*, Villers, 1789 and *Cynips lugdunaea* Gmelin, 1790 (Insecta, Hymenoptera).
- 2040. Designation of a type-species for *Madiza* Fallen, 1810 (Insecta, Diptera).

Comments should be sent in duplicate, citing case numbers, to the Secretary, International Commission of Zoological Nomenclature, c/o British Museum (Natural History), Cromwell Road, London SW7 5BD, England. Those received early enough will be published in the *Bulletin of Zoological Nomenclature*.—MARGARET GREEN, Scientific Assistant.

INDEX TO VOLUME 49

- Adams, new Coniopterygidae, 250
synonymy, 324
- Aethephemera**, 306
- Alcock, Behavior of Microbembex, 144
- Allen, new Ephemerellidae, 160
new Leptohyphes, 363
- Allen, new Comadia, 240
- Antonelli, larva and notes on Anthocomus, 56
- Araneida
Diguettidae, 110
- Arnaud, Parrish collection, 48
Cook obituary, 177
- Ayala, new Drosophila, 273
- Baetis **ellenae**, 285
- Baetodes **projectus**, 308
peniculus, 310
longus, 311
furvus, 313
- Bellinger, new Friesea, 389
- Benedetti, notes on Neomachilis, 246
- Bentzien, Biology of Diguettia imperiosa, 110
- Book reviews, 55, 101, 123, 143, 176, 184, 228, 239, 280, 281, 282, 283, 299
- Borboropsis **steyskali**, 374
- Brown, new Comadia, 240
- Campbell, new Diplolepsis, 174
- Chaetocnema **repens**, 62
- Chandler, revision of Formicilla, 31
new Hamotus, 255
new records, 288
Hamotus of Arizona, 378
- Chemsak, new Eburia, 338
- Chilenoperla **illiesi**, 318
- Chilcott, new Symphoromyia, 5
- Christian, new Friesea, 389
- Clark, records of black witch moth, 353
- Coleoptera
Anobiidae, 102
Anthicidae, 31, 67
Carabidae, 80, 126
Cerambycidae, 338
Chrysomelidae, 61
Cyathoceridae, 288
Georyssidae, 285
Lagriidae, 1
Pselaphidae, 255, 378
Scarabaeidae, 127
Staphylinidae, 42, 279
- Collembola, 389
- Comadia **suaedivora**, 240
- Dailey, unisexual generation of Andricus, 171
new Diplolepis, 174
synonymy of Andricus, 188
- Daly, fumigation of specimens, 377
lectotype designations, 383
- Denning, new Trichoptera, 132
- Dicrephemera**, 302
- Diplolepis **inconspicuis**, 174
- Diptera
Drosophilidae, 273
Heleomyzidae, 373
Phoridae, 403
Rhagionidae, 5
- Doutt, genus Paranaphoidea, 185
genus Paratrichogramma, 192
genus Polynemoidea, 215
fossil Mymaridae, 221
- Drosophila willistoni **quechua**, 276
equinoxialis **caribbensis**, 277
- Eburia **affluens**, 338
brevicornis, 339
brunneicomis, 340
elegans, 342
inarmata, 343
latispina, 344
megalops, 346
minutivestis, 347
opaca, 347
paraegrota, 348
poricollis, 351
submutata, 352
- Editorial notice, 25, 184
- Eighme, new Pulverro, 49
- Emmel, correction, 4
variability in Philotes, 74
- Ennik, Vespula parasite, 403
- Ephemerella (Drunella) **kabulensis**, 163
- Ephemrella (Serratella) **subsolana**, 164
- Ephemeroptera
Baetidae, 385, 308
Ephemerellidae, 160
Ephemeridac, 300
Tricorythidae, 363
- Eurytoma **adiacrita**, 354
bugbeeii, 356
daileyi, 359
- Farula **honeyi**, 137
peterstoni, 139
- Formicilla **longipilosa**, 35
alta, 39
vitrea, 40
- Foster, larva and notes on Anthocomus, 56
- Frankie, habits of Ernobius conicola, 102
- Friesea **cera**, 389
fara, 394
millsi, 389
polla, 934
quinta, 392
wilkeyi, 392
- Gardner, new milliped, 270

- Gilbert, behavior of *Trigona*, 21
Glossosoma sequoia, 132
 Goodpasture, new *Plebejus*, 149
 book review, 299
 Gordh, new *Trjapitzinellus*, 51
 Grigarick, *Macrobiotus*, 299
 eggs of *Macrobiotus*, 258
 Grissell, new *Torymidae*, 232
 new *Eurytoma*, 354
 Hammotus **cavus**, 255
 populus, 379
 Hardy, new *Phobetus*, 127
 Hemiptera
 Reduviidae, 183
 Rhopalidae, 196
 Homoptera
 Coccidae, 264
 Horn, *Leptocoris*, 196
 parasitization of *Malacosoma*, 402
 Hydropsyche **cora**, 135
 Hymenoptera
 Apidae, 21
 Cynipidae, 171, 174, 188
 Encyrtidae, 51
 Eurytomidae, 354
 Formicidae, 207, 396
 Ichneumonidae, 124, 197
 Megachilidae, 294
 Mymaridae, 185, 214, 221
 Pompilidae, 182
 Pteromalidae, 337
 Sphecidae, 26, 49, 144
 Tenthredinidae, 93
 Tiphidae, 325
 Trichogrammatidae, 192
 Incasemidalis **meinanderi**, 253
 Larochele, notes on *Scaphinotus*, 80
 wing dimorphism, 126
 Leech, note on *Ageniella*, 182
 book reviews, 101, 281, 282
 Legner, distribution of *Cafius*, 279
Leiomyrmosa, 325
 spilota, 326
 Lepidoptera, 149
 Lasiocampidae, 402
 Lycaenidae, 74
 Noctuidae, 353
 Nymphalidae, 289
 Leptohyphes **carinus**, 365
 edmundsi, 363
 flinti, 365
 invictus, 368
 jamaicanus, 371
 minimus, 369
 populus, 366
 rolstoni, 371
 tinctus, 368
 viriosus, 369
 Linsley, new *Eburia*, 338
Litus mexicanus, 223
 Lugaski, records of black witch moth,
 353
 Lysiopetalidea, 270
Manohyphella, 160
Manohyphella keiseri, 163
 Mathis, review of *Borboropsis*, 373
 Mayo, new *Baetis*, 385
 new *Baetodes*, 308
 McCafferty, classification of *Ephemera*,
 300
 McCrea, new flea beetle, 61
 Menke, lectotype designation, 257
 Miller, mealybugs, 264
Monodontomerus saltuosus, 232
 clementi, 235
 Moore, note on *Dacnochilus*, 42
 distribution of *Cafius*, 279
 Muchmore, new pseudoscorpions, 43
Murochernes, 43
Myrmosula boharti, 331
 latericarinata, 333
 nasuta, 329
 Nelson, synopsis of *Chilenoperla*, 315
 Neuroptera
 Coniopterygidae, 250, 324
 Nutting, new *Hamotus*, 255
 Paetzel, behavior of *Trypoxylon*, 26
Pampoconis punctipennis, 250
 uncinatus, 251
Paratrichogramma pretoriensis, 193
 californica, 195
 Parker, notes on *Lithurgus*, 294
 Parsons, *Lagriidae* of California, 1
Parthina vierra, 141
 Peterman, behavior in *Tanarthrus*, 67
Phobetus chearyi, 128
 Piper, new records for *Heteroschema*,
 337
Plebejus acmon texanus, 149
 Plecoptera, 315
Polynemoidea mexicana, 219
 Potter, notes on *Lithurgus*, 294
 Proceedings, Pacific Coast Entomologi-
 cal Society, 81
 Pseudoscorpionida, 43
 Pulverro **californica**, 49
 Rust, ectoparasites of *Thomomys*, 59
 Ryan, behavior of *Microbembex*, 144
 Schuster, *Macrobiotus*, 229
 eggs of *Macrobiotus*, 258
 Scorpionida
 Chactidae, 60
 Vejovidae, 165
 Shapiro, aberration in *Cynthia*, 289
 Shields, variability in *Philotes*, 74
 Slobodchikoff, studies of *Therion*, 197
 Smith, sawfly tribe *Lycaotini*, 93
 Soleglad, synonymy, 60
 redescription of *Vejovis*, 165
Spinolochus disolatus, 124
 Sprenger, unisexual generation of *An-
 dricus*, 171
 synonymy of *Andricus*, 188

- Statira **dumalis**, 1
 latitator, 3
 Stephen, hyperparasite, 395
 Symphoromyia **cervivora**, 6
 inconspicua, 12
 nana, 15
 truncata, 17
 Synaptoneura **vopida**, 96
 Tardigrada, 229, 258
 Thorp, book reviews, 55, 123, 143, 176,
 184, 228, 239, 280, 283
 Thysanura, 246
 Tinodes **gabriella**, 133
 Toftner, *Macrobiotus*, 229
 eggs of *Macrobiotus*, 258
 Torgersen, new *Spinolochus*, 124
 Torymus **frankiei**, 236
 memnonius, 237
 Trew, variability in *Philotes*, 74
 Trichoptera, 132
 Trjapitzinellus **microrphanos**, 51
 Turner, new *Symphoromyia*, 5
 Tynomma **schlingeri**, 270
 Wale, Cook obituary, 177
 Wasbauer, note on *Ageniella*, 182
 new *Myrmosinae*, 325
 Wheeler, ant larvae, 207
 ant larvae, 396
 Wood, *Triatoma protracta*, 183
 Zoological Nomenclature, 73, 404

MAILING DATES FOR VOLUME 49

- No. 1—January mailed 18 May 1973
 No. 2—April mailed 11 July 1973
 No. 3—July mailed 19 October 1973
 No. 4—October mailed 16 April 1974



Published by the
Pacific Coast Entomological Society
in cooperation with
The California Academy of Sciences

VOLUME FORTY-NINE

1973

EDITORIAL BOARD

J. T. DOYEN, *Editor*
J. A. CHEMSAK, *Assistant Editor*
E. G. LINSLEY
HUGH B. LEECH
E. S. ROSS
H. V. DALY
P. H. ARNAUD, JR., *Treasurer*

PUBLICATION COMMITTEE

1973	1974	1975
D. D. Linsdale E. I. Schlinger	J. A. Powell, Chairman M. A. Gardner	M. S. Wasbauer E. G. Linsley

San Francisco, California
1973

CONTENTS FOR VOLUME 49

Adams, P. A.	
Coniopterygidae from Chile, with three new species	250
Synonymy in <i>Pampoconis</i>	324
Alcock, J. and A. F. Ryan	
The behavior of <i>Microbembex nigrifrons</i>	144
Allen, R. K.	
New Ephemerellidae from Madagascar and Afghanistan	160
New species of <i>Leptohyphes</i> Eaton	363
Arnaud, P. H., Jr.	
Chris Parrish scorpion collection donated to California Academy of Sciences	48
Arnaud, P. H., Jr. and M. M. Wale	
Thomas Wrentmore Cook (1884–1962)	177
Ayala, F. J.	
Two new subspecies of the <i>Drosophila willistoni</i> group	273
Benedetti, R.	
Notes on the biology of <i>Neomachilis halophila</i> on a California sandy beach	246
Bentzien, M. M.	
Biology of the spider <i>Diguetia imperiosa</i>	110
Book Notices	245, 342
Book Reviews	55, 101, 123, 143, 176, 184, 228, 239, 280–283, 299
Brown, R. M. and R. P. Allen	
A new <i>Comadia</i> from the San Joaquin Valley of California	240
Chandler, D. S.	
A revision of the new world genus <i>Formicilla</i>	31
New records for Georyssidae and Cyathoceridae (Coleoptera) in Mexico	288
The <i>Hamotus</i> of Arizona	378
Chandler, D. S. and W. L. Nutting	
A new species of <i>Hamotus</i> from galleries of <i>Microtermes septen-</i> trionalis in Western Mexico	255

Chemsak, J. A. and E. G. Linsley New species of <i>Eburia</i> from Mexico	388
Christiansen, K. and P. Bellinger Six new Nearctic species of the genus <i>Friesea</i>	389
Dailey, D. C. and L. Campbell A new species of <i>Diplolepis</i> from California	174
Dailey, D. C. and C. M. Sprenger Unisexual generation of <i>Andricus atrimentus</i>	171
Synonymy of <i>Andricus gigas</i> and the bisexual generation of <i>Andricus crenatus</i>	188
Daly, H. V. Fumigation of museum specimens in oven-cooking bags	377
Lectotype designations of African bees of the genus <i>Ceratina</i> and allies	383
Denning, D. G. New species of Trichoptera	132
Doutt, R. L. The genus <i>Paranaphoidea</i> Girault	185
The genus <i>Paratrichogramma</i> Girault	192
The genus <i>Polynemoidea</i> Girault	215
The fossil Mymaridae	221
Eighme, L. E. A new <i>Pulverro</i> from California	49
Emmel, T. C. and J. F. Emmel Correction	4
Emmel, T. C., H. R. Trew, and O. Shields Chromosomal variability in a Nearctic Lycaenid butterfly, <i>Philotes sonorensis</i>	74
Ennik, F. <i>Apocephalus borealis</i> Brues parasitic upon <i>Vespula</i> spp.	403
Foster, D. E. and A. L. Antonelli Larval description and notes on the biology of <i>Anthocomus horni</i>	56
Frankie, G. W. Feeding habits and seasonal history of <i>Ernobius conicola</i> in cones of Monterey Cypress with notes on cohabiting insects	102

Gardner, M. R.	
A new milliped of the genus <i>Tynomma</i> from California	270
Gilbert, W. M.	
Foraging behavior of <i>Trigona fulviventris</i> in Costa Rica	21
Goodpasture, C.	
A new subspecies of <i>Plebejus acmon</i>	149
Book Review: An Index to the Described Life Histories, Early Stages and Hosts of the Macrolepidoptera of the Continental United States and Canada	299
Gordh, G.	
Description of a new species of <i>Trjapitzinellus</i> parasitic on Coniopterygidae in California	51
Grigarick, A. A., R. O. Schuster, and E. C. Toftner	
<i>Macrobiotus montanus</i> from California	229
Descriptive morphology of eggs of some species in the <i>Macrobiotus hufelandii</i> group	258
Grissell, E. E.	
New species of North American Torymidae	232
New species of <i>Eurytoma</i> associated with Cynipidae	354
Hardy, A. R.	
A new species of <i>Phobetus</i>	127
Horn, D. J.	
<i>Leptocoris rubrolineatus</i> , an occasional predator of the California oakworm, <i>Phryganidia californica</i>	196
Parasitization of <i>Malacosoma</i> larvae by Tachinidae in coastal California	42
Larochelle, A.	
Notes on the distribution and ecology of <i>Scaphinotus bilobus</i>	80
Wing dimorphism in <i>Carabus meander</i>	126
Leech, H. B.	
Book Review: Monografia da tribo Ibydionini	101
Lugaski, T. and W. H. Clark	
Collection records of the Black Witch Moth, <i>Ascalapha odorata</i> (Linnaeus) in Nevada	353
Mathis, W. N.	
A review of the genus <i>Borboropsis</i>	373

Mayo, V. K.	
A new species of <i>Baetis</i> from Ecuador	285
Four new species of the genus <i>Baetodes</i>	308
McCafferty, W. P. and G. F. Edmunds, Jr.	
Subgeneric classification of <i>Ephemera</i>	300
McCrea, R. J.	
A new species of the flea beetles genus <i>Chaetocnema</i> found on dichondra in California	61
Menke, A. S. and J. T. Polhemus	
Lectotype designation for <i>Gerris buenoi</i> Kirkaldy	257
Miller, D. R.	
Mealybugs of San Miguel Island, California	264
Moore, I.	
A note on <i>Dacnochilus fresnoensis</i>	42
Moore, I. and E. F. Legner	
Speculation on the distribution of the Southern California species of <i>Cafius</i> with a new record from the Salton Sea	279
Muchmore, W. B.	
A new genus of pseudoscorpions based upon <i>Atemnus hirsutus</i>	43
Nelson, C. H.	
Synopsis of the genus <i>Chilenoperla</i>	315
Paetzel, M. M.	
Behavior of the male <i>Trypozylon rubrocinctum</i>	26
Parker, F. D. and H. W. Potter	
Biological notes on <i>Lithurgus apicalis</i> Cresson	294
Parson, C. T.	
The Lagriidae of California	1
Peterman, R. M.	
Possible behavioral thermoregulation in <i>Tanarthrus salinus</i> and <i>T. inyo</i>	67
Piper, G. L.	
New distribution and host record for the parasitoid <i>Heteroschema</i> <i>aeneiventris</i>	337
Proceedings, Pacific Coast Entomological Society	81

Rust, R. W.	
Ectoparasites and nidicolous Acari of the pocket gopher, <i>Thomomys bottae</i>	59
Shapiro, A. M.	
Recurrent aberration in <i>Cynthia annabella</i> a review with four new records	289
Slobodchikoff, C. N.	
Behavioral studies of three morphotypes of <i>Therion circum-</i> <i>flexum</i>	197
Smith, D. R.	
The sawfly tribe Lycaotini in South America	93
Soleglad, M. E.	
<i>Uroctonoides fractus</i> a synonymy	60
A redescription of the scorpion <i>Vejovis flavus</i>	165
Stephen, F. M.	
<i>Ceratasmicra campoplegicis</i> Burks, a hyperparasite of <i>Perilitus</i> <i>coccinellae</i> (Shrank)	395
Thorp, R. W.	
Book Review: Principles of Insect Chemosterilization	55
Book Review: The Moths of America North of Mexico. Fasc. 21, Sphingoidea	143
Book Review: Biological Control	176
Book Review: Insect Vision	184
Book Review: Australian Butterflies	228
Book Review: Annual Review of Ecology and Systematics	239
Book Review: The Insects of Australia	280
Book Review: American Entomologists	281
Book Review: Monographie der Familie Platypodidae Coleop- tera	282
Book Review: Essays in Evolution and Genetics in Honor of Theodosius Dobzhansky	283
Torgersen, T. R.	
A new species of <i>Spinolochus</i> from North America	124
Turner, W. J. and J. G. Chillcott	
Four new species of the <i>Symphoromyia pachyceras</i> complex from California	5

Wasbauer, M. S.	
Some new taxa in the Myrmosinae with keys to the females in North America	325
Wasbauer, M. S. and H. B. Leech	
A biological note on two species of <i>Ageniella</i> from California	182
Wheeler, G. C. and J. Wheeler	
The ant larvae of the tribes Basicerotini and Dacetini: second supplement	207
Ant larvae of the subfamily Dolichoderinae: second supplement ..	396
Wood, S. F.	
Recent annoyance to man in Utah by <i>Triatoma protracta</i>	183
Zoological Nomenclature	73, 404

ENTOMOLOGICAL EXCHANGES AND SALES

Space is available to members and non-members who wish to advertise entomological exchanges, sales, announcements, etc. We can offer an ad in four issues for \$1.50 per line. Ads will be arranged in order of their receipt. Contact the Advertising Manager, W. H. Lange, Department of Entomology, University of California, Davis, California 95616.

FOR SALE. Extensive collection of mayfly reprints. Write R. Brusca, Department of Biology, University of Arizona, Tucson, 85721.

FOR SALE. Over 900 species of butterflies from the Malaysian and Indonesian Jungles, very rare moth (14" wing span), Scorpion, giant sized Indonesian flying lizard, centipedes, stick insects, all types of rhinoceros beetles and rare beetles in the families Scarabaeidae, Lucanidae, Mordellidae, Cerambycidae, etc. Write Sim Yam Seng, 21, Joon Hiang Road, Singapore, 19, Singapore.

EXCHANGE. Eastern U.S. and exotic Scarabaeidae, Cerambycidae, or Cicindelidae for western U.S. Cicindelidae. John D. Glaser, 6660 Loch Hill Rd., Baltimore, Md. 21239.

COMMERCIAL AND RESEARCH ENTOMOLOGISTS

Obtain more accurate population counts
with a light-weight motor-fan unit
which sucks insects into nets

D-VAC
MOTOR-FAN VACUUM INSECT NETS
BACK-PACKS AND HAND MODELS

-also-

BENEFICIAL INSECTS
INSECTARY GROWN AND FIELD COLLECTED
Trichogramma sp. and Green Lacewings

Write for Brochures

D-VAC CO.
P. O. Box 2095
RIVERSIDE, CALIFORNIA

INSECT PINS

\$5. / 1000 (10 Pkgs.)
(Plus Postage) 12c per 1000

PROMPT DELIVERY
LOWEST PRICES IN AMERICA

CLAIR ARMIN
191 W. Palm Avenue
Reedley,
California 93654
ph. (209) 638-3729

THE MOTHS OF AMERICA NORTH OF MEXICO

THE MOTHS OF AMERICA, one of the most significant publications in the history of American entomology, will contain full-color photographs of all 10,000+ species of North American moths. The color photography has been done with excruciating care and attention to detail, and must be seen to be believed.

THE MOTHS OF AMERICA, written by authorities in each group treated, constitutes a thorough review of the North American moths, with descriptions of new genera and species where appropriate.

In addition to the color photographs of adults, illustrations of genitalia or other structures are included where necessary to assure accurate identification. The comprehensive text gives a full taxonomic treatment, including synonymy, plus information on distribution, foodplants, biology, and other aspects of each species.

THE MOTHS OF AMERICA will be published in over 100 parts, over a period of about 20 years. Each part is individually priced, according to its size, number of color plates, and number of copies printed. Three to five parts are expected each year.

Special pre-publication/subscription prices, about 20% less than the regular list prices, apply to subscriptions for the entire work and to orders received prior to the publication of specific parts. (NOTE: The only way to get the parts already published at the reduced prices is to subscribe to the entire series.)

Please start your subscription now, or order the parts you desire, before the cost becomes prohibitive.

ALREADY PUBLISHED:

Fascicle 13, Part 1a, Pyralidae: Scopariinae & Nymphulinae, by Dr. Eugene G. Munroe. 1972. 134 p. \$20.60 (\$16.50 to subscribers).

Fascicle 13, Part 1b, Pyralidae: Odontiinae & Glaphyriinae, by Dr. Eugene G. Munroe. 1972. 116 p. \$20.60 (\$16.50 to subscribers).

Fascicle 20, Part 2a, Bombycoidea: Saturniidae, in part (Citheroniinae and Hemileucinae, in part), by Dr. Douglas C. Ferguson. 1972. 153 p., 11 color plates, 19 figs. \$39.00 (\$32.50 to subscribers).

Fascicle 20, Part 2b, Bombycoidea: Saturniidae, in part (Hemileucinae, in part, and Saturniinae), by Dr. Douglas C. Ferguson. 1972. xxi + 121 p., 11 color plates, 11 figs. \$39.00 (\$32.50 to subscribers).

Fascicle 21, Sphingoidea, by Dr. Ronald W. Hodges. 1971. xii + 158 p., 16 plates (14 in color), 8 halftones, 19 figs. \$24.00 (\$19.60 to subscribers).

IN PREPARATION:

Fascicle 20, Part 1, Bombycoidea (excluding Saturniidae) (i.e., Lasiocampidae, Mimallonidae, Apetelodidae, and Bombycidae), by Dr. J. G. Franclemont.

Fascicle 13, Part 1c, Pyralidae: Evergestiinae, by Dr. Eugene G. Munroe (including 14 color plates for all 3 parts of Fascicle 13. 1).

Fascicle 6, Part 2, Gelechioidea: Oecophoridae, by Dr. Ronald W. Hodges.

Fascicle 22, Part 2, Lymantriidae, by Dr. Douglas C. Ferguson.

Also in preparation: Notodontidae, Cosmopterygidae, Walshiiidae, and Aegeriidae.

THE MOTHS OF AMERICA NORTH OF MEXICO belongs on the shelf of every serious lepidopterist and in every significant library. Please make sure that your local library subscribes, so that this important reference work will be available to you and your colleagues in the future.

A fully descriptive brochure, with sample color plate and order form, is available on request.

THE MOTHS OF AMERICA NORTH OF MEXICO is distributed exclusively in North America by:



Entomological Reprint Specialists

P.O. Box 77224, Dockweiler Station, Los Angeles, California 90007, U.S.A.

Entomological Reprint Specialists sells any insect book in print. Please write for price lists or quotations.

THE PAN-PACIFIC ENTOMOLOGIST

Information for Contributors

Papers on the systematic and biological phases of entomology are favored, including articles up to *ten* printed pages on insect taxonomy, morphology, behavior, life history, and distribution. Excess pagination must be approved and may be charged to the author. Papers are published in approximately the order that they are received. Immediate publication may be arranged *after* acceptance by paying publication costs. Papers of less than a printed page may be published as space is available, in SCIENTIFIC NOTES.

Manuscripts for publication, proof, and all editorial matters should be addressed to the Editor, John T. Doyen, Division of Entomology & Parasitology, University of California, Berkeley, California 94720.

Typing.—All parts of manuscripts must be typed on bond paper with double-spacing and ample margins. Carbon copies or copies on paper larger than $8\frac{1}{2} \times 11$ inches are not accepted. Do not use all capitals for any purpose. Underscore only where italics are intended in the body of the text, not in headings. Number all pages consecutively and put author's name at the top right-hand corner of each sheet. References to footnotes in text should be numbered consecutively. Footnotes should be typed on a separate sheet.

First page.—The page preceding the text of the manuscript should include (1) the complete title, (2) the order and family in parentheses, (3) the author's name or names, (4) the institution with city and state or the author's home city and state if not affiliated, (5) the shortened title (running headline) not to exceed 38 letters and spaces when combined with the author's last name or names, (6) the complete name and address to which proof is to be sent.

Names and descriptions of organisms.—The first mention of a plant or animal should include the full scientific name with the author of a zoological name *not* abbreviated. Do not abbreviate generic names. Descriptions of taxa should be in telegraphic style.

References.—All citations in text, e.g., Essig (1926) or (Essig, 1958), should be listed alphabetically under LITERATURE CITED in the following format:

Essig, E. O. 1926. A butterfly migration. Pan-Pac. Entomol.,
2: 211-212.

1958. Insects and mites of western North America. Rev.
ed. The Macmillan Co., New York. 1050 pp.

Abbreviations for titles of journals should follow the list of *Biological Abstracts*, 1966, 47(21) : 8585-8601.

Tables.—Tables are expensive and should be kept to a minimum. Each table should be prepared as a line drawing *or* typed on a separate page with heading at top and footnotes below. Number tables with Arabic numerals. Number footnotes consecutively for each table. Use only horizontal rules.

Illustrations.—No extra charge is made for the line drawings or halftones. Submit only photographs on glossy paper and original drawings (no photographs of drawings). Authors *must* plan their illustrations for reduction to the dimensions of the printed page ($4\frac{1}{8} \times 6\frac{3}{4}$ inches). If possible, allowance should be made for the legend to be placed beneath the illustration. Photographs should not be less than the width of the printed page. Drawings should be in India Ink and at least twice as large as the printed illustration. Excessively large illustrations are awkward to handle and may be damaged in transit. Include a metric scale on the drawing or state magnification of the *printed* illustration in the legend. Arrange figures to use space efficiently. Lettering should reduce to no less than 1 mm. *On the back of each illustration* should be stated (1) the title of the paper, (2) the author's complete name and address, and (3) whether he wishes the illustration and/or cut returned to him *at his expense*. Cuts and illustrations not specifically requested will be destroyed.

Figure legends.—Legends should be typewritten double-spaced on separate pages headed EXPLANATION OF FIGURES and placed following LITERATURE CITED. Do not attach legends to illustrations.

Proofs, reprints, and abstract.—Proofs and forms for the abstract and reprint order will be sent to authors. Major changes in proof will be charged to the author. Proof returned to the editor without the abstract will not be published.

Page charges.—All regular papers of one to ten printed pages are charged at the rate of \$18.00 per page. This is in addition to the charge for reprints and does not include the possible charges for extra pagination or the costs for immediate publication. Private investigators or authors without institutional or grant funds to cover this charge may apply to the Society for a grant to cover the page charges. A mark in the appropriate box (society grant desired) on the reprint order form will suffice as an application.

All articles are accepted for publication *only* on the basis of scientific merit and without regard to the financial support of the author.

**PUBLICATIONS
OF THE
PACIFIC COAST ENTOMOLOGICAL SOCIETY**

PROCEEDINGS OF THE PACIFIC COAST ENTOMOLOGICAL SOCIETY.

Vol. 1 (16 numbers, 179 pages) and Vol. 2 (numbers 1-9, 131 pages). 1901-1930. Price \$2.50 per volume.

PAN-PACIFIC ENTOMOLOGIST.

Vol. 1 (1924) to present. Price \$10.00 per volume of 4 numbers, or \$2.50 per single issue.

MEMOIR SERIES.

Volume 1. *The Sucking Lice* by G. F. Ferris. A 320-page book which summarizes the knowledge of the Anoplura of the world. Published October 1951. Price \$6.00. (Plus 35¢ postage.)*

Volume 2. *The Spider Mite Family Tetranychidae* by A. Earl Pritchard and Edward W. Baker. This worldwide treatment deals with the systematics, identification, and economics of the "Red Spiders" and includes descriptions of 33 new species. 472 pages. Published July 1955. Price \$10.00. (Plus 50¢ postage.)*

Volume 3. *Revisionary Studies in the Nearctic Decticinae* by David C. Rentz and James D. Birchim. This 173-page revision of Nearctic shield-back katydids includes descriptions of one new genus and 13 new species and subspecies. Published July 1968. Price \$4.00. (Plus 25¢ postage.)*

Volume 4. *Autobiography of an Entomologist* by Robert L. Usinger. A 343 page book relating the life story of one of the outstanding entomologists of our time. Published August 1972. Price \$15.00. (Plus 40¢ postage.)*

* (Add 5% sales tax on all California orders. Members of the Society will receive a 20% discount.)

Send orders to:

Pacific Coast Entomological Society
c/o California Academy of Sciences
Golden Gate Park
San Francisco, California 94118